

AN ECONOMIC ANALYSIS OF THE HOME MORTGAGE  
DEFAULT INSURANCE MARKET WITH EMPHASIS  
ON THE DECLINE OF FHA

By

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"However, just as pressing is the need to reappraise in the comprehensive manner the entire FHA program and to determine its future role in serving national housing needs"--Wright Patman, *Congressional Record*, August 15, 1974.

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DEFAULT INSURANCE MARKET WITH EMPHASIS  
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By

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The home mortgage default insurance programs of the Federal Housing Administration (FHA) have experienced a precipitous decline in the volume of contracts written in recent years. This decline in insurance activity has been accompanied by increasing claims that have placed a considerable burden on the insurance funds that support these programs. The major program providing unsubsidized (actuarially sound) coverage for mortgages written on single-family housing units has been the Section 203 program which has been severely affected by the declining volume of insurance activity.

The fundamental question addressed in this study is whether this decline in FHA insurance activity has been the result of internal program inefficiencies or increasing competitive pressures from the private firms in the market. This is the crucial issue that should determine the primary thrust of the federal government's future policies in this area.

In attempting to address this basic issue, this study develops a theoretical model of the home mortgage default insurance market. This market is determined by the actions of three sets of participants:

the mortgagor, the mortgagee, and the supplier of default insurance coverage. The first two sets of these participants interact in what is viewed as a competitive mortgage market under conditions of default loss uncertainty to determine the market demand for mortgage default insurance. Thus, this demand is seen as being derived in nature, with its primary source found in the demand for and supply of mortgage funds. The last set of market participants (the suppliers of default coverage) is composed of four major actors: the FHA Section 203 program, the FHA subsidized housing and mortgage insurance programs, the Veterans Administration home loan guarantee program, and the private mortgage insurance industry. Of these four actors, the last three are viewed as being subject to supply constraints of an institutional nature which result in their services being rationed. The notion that these constraints remain effective is a fundamental maintained hypothesis throughout the analysis. Finally, the coverage supplied by the various actors in the market is considered to be non-homogeneous but substitutable. This results in the overall mortgage default insurance market being determined from the operations occurring in four inter-related sub-markets (one for each supplier of coverage).

This theoretical model is then used to specify a system of partially simultaneous equations that depicts the important relationships that determine total insurance market activity and the individual insurance activities in each of the four sub-markets. Estimation of this model using quarterly time series data that cover the postwar period yields results that, in general, support that theoretically derived hypotheses concerning the causal forces at work. Such estimation also yields quantitative approximations to the marginal influences

of the various factors that have led to the decline in insurance activity under Section 203.

There are a number of conclusions that are drawn from this model concerning the overall functioning of the home mortgage default insurance market. The most significant result for policy purposes, however, is the finding that insurance volume losses experienced by FHA have been primarily determined by market-oriented (as opposed to program-oriented) influences. The important implication of this finding is that policy actions that are intended to rejuvenate FHA's activity in this market should be avoided.

## CHAPTER I INTRODUCTION

The home mortgage default insurance programs of the Federal Housing Administration have helped to serve the nation's housing needs for the last forty-one years. During this period, the basic service that has been rendered by these programs has been the provision of insurance coverage against default loss on individual mortgages originated by private lenders. It is generally felt that such insurance has encouraged a larger supply of mortgage funds on more liberal financing terms than would have been forthcoming in the absence of these programs. It is also felt that these funds have, in turn, increased the effective demand for housing services as the feasibility of home ownership has been expanded to a larger segment of the overall population.

The public purpose served by the FHA insurance programs is now being called into question, and a fundamental reexamination of the federal government's role in the market appears to be imminent. The need for some basic revisions seems to have been created by an evolutionary process that has brought forth fundamental structural and institutional changes in the mortgage lending and default insurance markets over the last decade. Partly as a result of these long run changes and partly as a result of specific operational inadequacies, the FHA single family programs have experienced increasing difficulties in recent years both in maintaining an adequate volume of insurance

activity and in achieving the Congressional objective of actuarial soundness.<sup>1</sup>

These difficulties are now providing the catalyst for major policy decisions that will determine the future role of FHA in the insurance of home mortgage default risk. Such decisions should be based upon the most complete information that can reasonably be made available in order to ensure that short run reactions to the existing situation do not result in the design of policies or programs that will have undesirable long run effects. The likelihood that such effects will be generated may be reduced with each additional piece of relevant information provided to decision makers. It is the purpose of this study to provide such information in the form of an economic model of the home mortgage default insurance market.

The model that has been derived for this purpose determines both the volume of insurance written by the total market and the individual volumes of insurance written by the various supply-side participants in that market over time. In so doing, the model contributes to the existing economic literature relating to the theory of mortgagor default behavior, the mortgage origination process, and the overall operation of the default insurance market. At the same time, the model can be used to provide a detailed explanation of the causal events that have led to the current problems of FHA and, thereby, serve as an important input to the decision-making process. Thus, the study has two broad objectives: to contribute to the literature providing an economic analysis of home mortgage default risk and the default insurance market;

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<sup>1</sup>Actuarial soundness is used here to mean a non-negative reserve accumulation net of operating expenses, i.e., a self-financing program.

and to provide an explanation of the process that has led FHA to its current situation.

With regard to FHA, the study will be seen to give particular attention to the insurance volume and claims experience of the Section 203 program. This program is the oldest and by far the largest of the single-family programs, accounting for almost 80 percent of the cumulative insurance written by units and nearly 77 percent of the estimated insurance in force in dollars at the end of June, 1973 (*Summary of Mortgage Insurance Operations and Contract Authority*, 1973, p. 1). The Section 203 program has been the mainstay of the general insurance operations of FHA since its origination in 1934, and it has been the continuing loss of business being carried out under this program in recent years that has created the great concern of both the administrators in charge of these insurance operations and the decision makers involved in federal housing policy.

A clear understanding of the causes of this decline is essential in the design of future policies relating to the operation of the program. Completely different approaches are warranted by different causes of decline. For example, if the Section 203 insurance program has declined because of identifiable changes in the program's operations that have generated internal inefficiencies which have, in turn, led to the neglect of basic default insurance market needs, then a corrective approach would appear to be appropriate. But, on the other hand, if the declining insurance volume has been primarily generated through a growth in competition in the default insurance market that has enabled mortgagors to obtain preferred coverage from other sources, then it would seem appropriate for federal decision makers to examine

whether there exists a public need for continuation of the program. Hopefully, the findings of this study will provide information for the design of future policies relating to the provision of home mortgage default insurance on the part of the federal government.

The study itself is divided into seven chapters. Following this brief introductory chapter, the history and institutions relevant to the default insurance market are presented in Chapter II along with a detailed documentation of the decline in insurance activity under the Section 203 program. Then, a brief review of some economic literature that is relevant to the default insurance market is given in Chapter III. Chapter IV is devoted to the development of a theoretical model of default risk and the default insurance market that explains the mechanisms involved in the determination of total market insurance activity and the individual insurance activities of the various suppliers of default coverage in that market. This model is then employed in Chapter V to specify an empirical model of the default insurance market that can be used to estimate the marginal influence of each of the causal factors that are implied by the theoretical considerations of the preceding chapter. The estimation results obtained from this empirical model and their interpretations are given in Chapter VI. And finally, the basic conclusions relating to both overall default insurance market operations and the decline of Section 203 are drawn in Chapter VII. Additionally, this final chapter contains a summary of the study and a discussion of some promising areas for future research.

CHAPTER II  
HISTORY AND ENVIRONMENT OF THE  
FHA SECTION 203 PROGRAM

Depression Conditions and Federal Response

The Federal Housing Administration's basic programs providing default insurance on privately financed mortgage contracts were originally conceived during the Great Depression as a direct response by the federal government to the depressed conditions of the economy in general and the building and construction trades sector in particular. The state of the economy at that time was such that the flow of funds through the nation's mortgage markets had been reduced to a trickle, and residential construction activity had virtually ceased. The production of new homes had dropped to 93,000 units in 1933 (less than 10 percent of the number built in 1925), and on-site construction employed only 150,000 people throughout the entire economy (H. R. Report No. 897, 81st Congress, pp. 56-67). Harry L. Hopkins, the Federal Emergency Relief Administrator, in testimony before the Housing Banking and Currency Committee on May 18, 1934, stated

The building trades in America represent by all odds the largest single unit of our unemployment. Probably more than one-third of all the unemployed are identified, directly or indirectly, with the building trades...(Foard and Frantz, 1973, p. III, 3).

In addition, approximately one half of all home mortgages were in default, and foreclosures were occurring at the phenomenal rate of over one thousand per day (Foard and Frantz, 1973, p. II, 9).

The response by the federal government to these serious conditions consisted of an array of housing and mortgage related programs that were created over the six year period from 1932 to 1938. Among these were the basic FHA mortgage insurance programs, including the single-family unsubsidized Section 203 program with which this study is concerned. Prior to describing this program in some detail, however, it will be useful to list and briefly describe some of the other important institutions created in this period that relate to the housing and mortgage markets.<sup>1</sup> This will give the reader an indication of the degree of attention that was devoted to this sector of the economy at this time and provide a rough description of the institutional environment surrounding the Section 203 program.

1. The Federal Home Loan Bank Board was created under authority of the Federal Home Loan Bank Board Act of 1932 in order to organize, incorporate, examine, and regulate a system of federal savings and loan associations. The primary objective of this institution was to encourage the development of local mutual thrift institutions in which individuals could safely invest funds in order to provide for the financing of home purchases (Foard and Frantz, 1973, p. II, 11).

2. The Home Owners' Loan Corporation was created under authority of the Home Owners' Loan Act of 1933 with the objective of refinancing home mortgages that were in default or process of foreclosure. In addition, this institution was given the authority to originate direct loans to permit former homeowners to recover properties that had been

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<sup>1</sup>The descriptions provided of these institutions are necessarily brief and indicate only the most important actions taken and objectives expressed. Those seeking a more detailed treatment of these and other federal housing programs should see Foard and Frantz (1973).

lost through foreclosure or forced sale (Foard and Frantz, 1973, p. II, 10).

3. The Federal Savings and Loan Insurance Corporation was created under authority of the National Housing Act of 1934 with the basic intention of encouraging additional deposit inflows at savings and loan associations by removing the risk of loss through association insolvency. The service provided to the savings and loan association by this institution is analogous to that provided to the commercial banking system by the Federal Deposit Insurance Corporation (Foard and Frantz, 1973, pp. II, 13-14).

4. The Reconstruction Finance Corporation Mortgage Company was created under authority of a 1935 amendment of Title III of the National Housing Act of 1934 (Public Law 1, 74th Congress). The purpose of this institution was to assist in the re-establishment of a nationwide mortgage market by investing in many types of mortgage instruments, both residential and commercial, where such funds were not obtainable at reasonable rates from private sources. Purchases by this institution, however, primarily consisted of FHA-insured (and, later, VA-guaranteed) mortgages that had been originated by private lenders. The Corporation was dissolved by act of Congress in 1948 (Public Law 132, 80th Congress) (Foard and Frantz, 1973, pp. IV, 8-9).

5. The Federal National Mortgage Association (FNMA) was created under authority of a 1938 amendment of Title III of the National Housing Act of 1934 (Public Law 424, 75th Congress). The objective behind the creation of this institution was that FNMA would function alongside the Reconstruction Finance Corporation Mortgage Company in establishing a national secondary mortgage market in which mortgage obligations could

be traded as financial investment assets. Such a market, it was felt, would encourage inter-regional arbitrage operations that would reduce the wide variations that existed in mortgage financing availability and interest rates across the country. Also, it was felt that the added liquidity given to the mortgage instrument by the functioning of an active secondary market would increase the willingness of institutional investors to commit funds to this kind of long-term instrument (Foard and Frantz, 1973, pp. IV, 9-10).

While various other programs and policies that were designed to stimulate the depressed mortgage and housing sectors were adopted at all levels of government during this period, the above list, with the obvious exclusion of the FHA mortgage insurance programs, provides adequate documentation of the degree of effort that was expended at the federal level.<sup>2</sup> We turn, now, to a somewhat detailed description of the major single-family program excluded from the above list--the FHA Section 203 mortgage insurance program.

The enabling legislation for this insurance program was the National Housing Act of 1934. This act laid out the administrative framework within which FHA was to operate and indicated what the various constraints that were to be placed on the program were to be. Section 203 of Title II of this act provided for the insurance of approved private lenders against losses arising from mortgagor defaults on first mortgage loans originated on single-family properties.

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<sup>2</sup>It is of interest to note that all of the above programs (and the vast majority of federal housing programs created since that time) operate primarily through the financial (mortgage) sector rather than directly through the real (housing) sector. This tendency has resulted in most of the federal effort in this area having its primary impact on the demand side of the housing market.

This legislation placed ceilings of twenty years on the term to maturity and 80 percent on the loan-to-value ratio on insured loans and limited the size of the eligible mortgage to \$16,000 or less. The interest rate allowed on insured loans was limited to 5 percent per annum on the outstanding balance and the property securing the loan was required to be "economically sound." The settlement of insurance claims in the event that the loan was foreclosed required that the lender convey the property and all relevant claims against it to FHA for which we would receive in return: (1) debentures guaranteed by the U.S. government equal to the outstanding balance on the loan plus certain other allowances, with these debentures maturing three years after the contract maturity on the mortgage obligation and carrying an interest rate fixed by FHA with the consent of the U.S. Treasury based upon current yields of U.S. bonds (later, FHA was given the option of paying this insurance claim in cash); and (2) a certificate of claim redeemable in cash equal to the earned but unpaid interest of the loan plus partial reimbursal of foreclosure costs, with these items payable only to the extent that FHA realized net proceeds from handling the property (Foard and Frantz, 1973, pp. III, 4-5; Bartke, 1967, p. 654).

With regard to the financing of FHA's Section 203 program, the intent of Congress was that, after an initial period of negative returns during which start-up costs would be absorbed and insurance reserves accumulated, the program would become self-financing (i.e., actuarially sound). The legislation, therefore, required that an insurance premium be levied on the mortgagor and be collected monthly with the mortgage installments. The exact premium rate was not stipulated by the act, but rather, a range of allowable premium rates was set within which FHA

was authorized to peg the actual premium--this range being one-half to one percent per annum of the outstanding mortgage balance. While all of the other contract term limits placed on FHA-insured loans (the allowable term to maturity, loan-to-value ratio, mortgage amount, and interest rate) have been altered from time to time in order to, at least partially, reflect market developments, the insurance premium charged for FHA coverage has remained fixed at one-half percent for all loans insured under Section 203 since 1934. This has been an important feature of the Section 203 program to which we will return several times in this study.

#### Section 203's Major Objectives

As with the majority of federal programs created at that time, the immediate objective of the FHA Section 203 insurance program was to increase employment, with its initial impact, obviously, directed toward the building and construction trades sector. Also, the long term objective of increasing the nation's overall consumption of housing services in terms of both the quantity and quality of the units consumed through a general improvement in the financing terms available in the mortgage market was made clear in the hearings leading up to the actual legislation. The House Committee Report stated the intent as

...to improve Nation-wide housing standards, provide employment, and stimulate industry; to improve conditions with respect to home-mortgage financing, to prevent speculative excess in new-mortgage investment, and to eliminate the necessity for costly second-mortgage financing (House of Representatives Report No. 1922, 73rd Congress, 2nd Session, 1934, p. 1).

These basic objectives have remained in effect for the Section 203 program over the years. Additional objectives, such as the encouragement

of homeownership among lower income families, have generally been attacked by the creation of additional programs within the FHA insurance system.<sup>3</sup>

The basic concept of providing mortgage lenders with default insurance protection was not without precedent. A private mortgage insurance industry has existed prior to the creation of FHA, having grown out of the title insurance business in the late 1800's and early 1900's. There were, however, almost no regulatory constraints placed on the firms in this industry either by the federal government or by the various states in which they operated (primarily New York). As a result, there developed a great deal of fraud and misrepresentation in the industry, and the contingency reserves held by these firms were dangerously low in the late 1920's and early 1930's. In a report to the governor of the State of New York in 1934, George Alger, a special commissioner appointed to investigate the operations of the private mortgage insurance industry, stated

The value of a guaranty depends, of course, on what is back of it. These companies were growing by leaps and bounds and issuing these guarantees in continually increasing volume. The need of some safeguard in the law requiring a fixed relationship between capital and guarantees seems obvious. New York, where the bulk of this business was done, placed no limit upon the amount of contingent obligations which such a company might assume. Without a limit on the amount of guarantees assumed, the only protection for investors would be in the amount of required capital and in the safeguards placed upon their investments. In these respects investors were similarly unprotected (Alger, 1934, p. 15).

In addition to this basic weakness, the industry exhibited a fundamental contradiction of sound insurance practice in that the majority

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<sup>3</sup> A discussion of the growth and evolution of FHA's housing objectives may be found in Bartke (1967).

of its contingency reserves were held in mortgage obligations, which were subject to the same risks that they were being held to offset. With the crash of 1929 and the ensuing flood of foreclosure activity and, hence, insurance claims, the private mortgage insurance industry failed. The actual collapse was postponed for a brief period by ambiguous accounting practices and actual falsification of insurance losses as the firms in the industry attempted to delay the inevitable result in the hope that an early economic recovery would bolster the value of their declining reserves and reverse the downward trend in premium and investment income. But, by the end of March, 1933, all firms in the industry were bankrupt. In response to this event, most states enacted legislation forbidding private firms from selling mortgage insurance within their boundaries, and many of these states prohibitions have remained in effect until very recently.<sup>4</sup> Consequently, a major impetus for the federal government adopting the role of a mortgage insurance supplier was that a private market for this type of coverage simply did not exist at that time.

The theoretical mechanisms through which the provision of default insurance protection was to stimulate employment in the residential construction sector were hinted at in various places throughout the enabling legislation and the hearings preceeding that legislation. Many general references were made which indicated that insurance coverage would increase investment in home mortgages and, thereby, increase housing and construction activity. But, the theoretical links through

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<sup>4</sup>Those seeking further information on the early history of the private mortgage insurance industry should read Alger (1934), Graaskamp (1970), Kohlhoss (1972), Rapkin (1973, 1974), and Little (1975).

which this effect would take place were not laid out. One can, however, trace through the likely effects of default insurance protection and deduce the probable impact on the mortgage market and housing industry by employing a highly simplified model of the housing and mortgage markets.<sup>5</sup> From the standard microeconomic assumptions, one should be able to derive the individual's demand function for housing services, with the typical result that the quantity of housing demanded will bear a functional relation to the price of housing services, the individual's income, and the prices of related goods. Then, the individual's demand function could be written as

$$(1) \quad D_h = F(P_H, y, P_1, \dots, P_n)$$

where  $D_h$  is the quantity of housing services demanded by the individual (where this quantity measure incorporates all structural, locational, and neighborhood characteristics of the unit--see Olsen, 1969),  $P_H$  is the real price of housing services,  $y$  is the individual's real income, and  $P_1, \dots, P_n$  are real prices of related goods. We know that  $\frac{\partial D_h}{\partial P_H} < 0$  and, if housing is a normal good,  $\frac{\partial D_h}{\partial y} > 0$ .

Since most individuals are not financially able to pay cash for a house, a mortgage is generally required for homeownership.<sup>6</sup>

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<sup>5</sup>The skeletal model outlined here is not taken directly from any existing housing or mortgage market models but, instead, represents a synthesis of many treatments of the subject and my own views concerning the operation of these markets. In my view, the theoretical underpinnings of a great deal of the work in this area are extremely weak and of an *ad hoc* nature. At this time, a truly rigorous theoretical model of the interactions that take place between the housing market, the mortgage market, and the default insurance market does not exist.

<sup>6</sup>One can, of course, consume housing without purchasing the asset providing the service by renting. Other factors, such as differences in tax treatment, preferences for mobility, etc., should influence the individual's choice concerning the ownership of the asset providing the

Consequently, the demand for mortgage funds is a derived demand, having as its direct source the demand for housing services. Because of this, the mortgage loan may be conveniently viewed as a good that is complementary to the consumption of housing services. Being complementary, we know that the cross price elasticity of demand between housing services and mortgages will be negative. Letting the mortgage be denoted as good  $j$ , we know that  $\frac{D_h}{P_j} < 0$ , where  $P_j$  is the effective rate of interest on mortgage loans.<sup>7</sup>

In graphical terms, we could translate the above demand function into an individual demand schedule for housing services with the price of housing services on the ordinate and the quantity demanded on the abscissa. Then, a change in the price of mortgage funds would result in a shift in the demand schedule for housing services--with, of course, a reduction in the price of these funds resulting in an increase in the quantity of housing services demanded at any given price. Thus, a reduction in the price of mortgage credit (the effective interest rate) results in an increase in the individual's demand schedule for housing services. Summing these individual demand schedules horizontally, we obtain the market demand schedule for housing services, given by  $D_H$ , which will exhibit similar qualitative relationships to the price of housing services and the price of mortgage funds.

The introduction of mortgage insurance would have the effect of reducing the effective price of mortgage funds,  $P_j$ , and thereby, shift

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housing service. For those individual's opting for homeownership, however, a mortgage is generally (though not always) required.

<sup>7</sup> Present estimates of the interest rate elasticity of the demand for single-family homes range from -0.6 to -2.8 (von Furstenberg, 1975, p. 18).

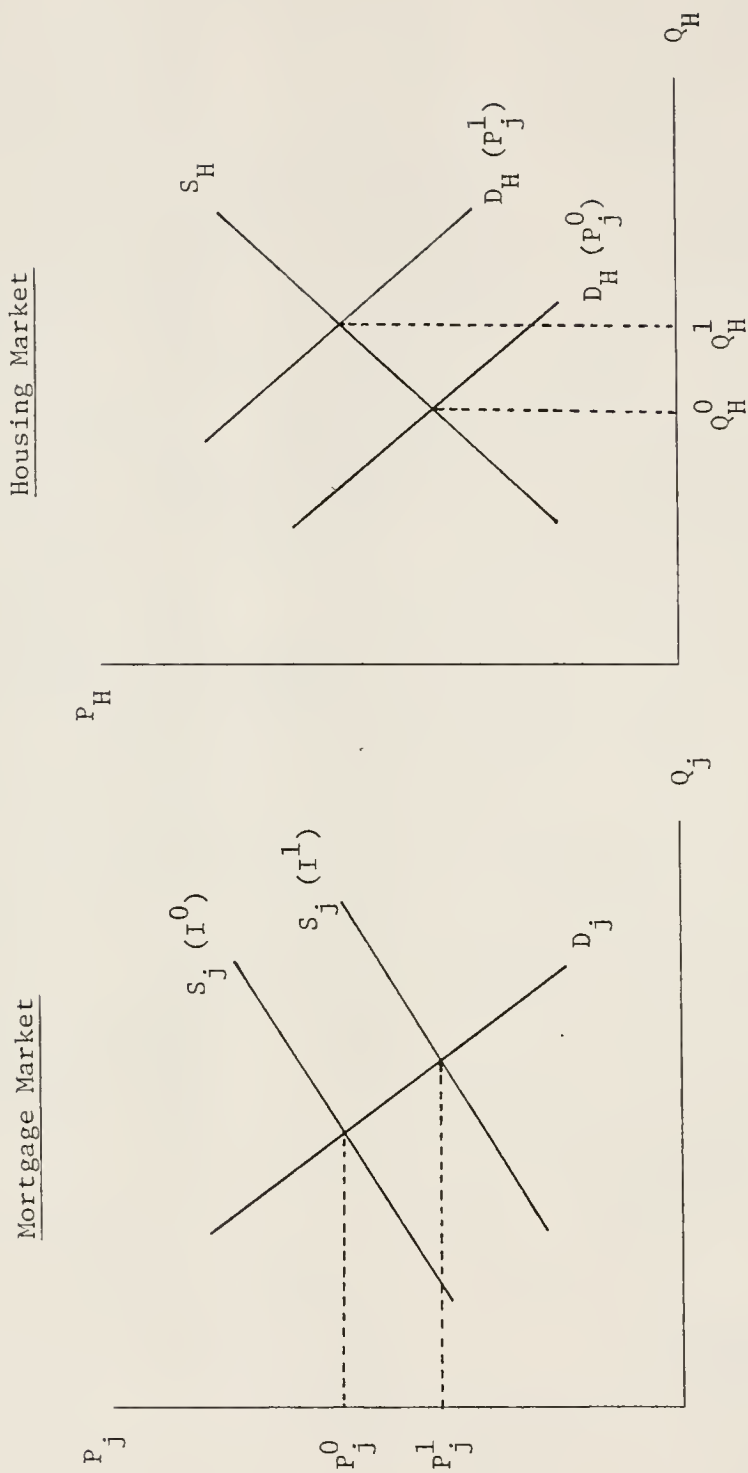
the market demand schedule for housing services to the right. This reduction in  $P_j$  is brought about by an increase in the supply of mortgage funds stimulated by the reduction in the relative risk of the mortgage instrument as an investment alternative.<sup>8</sup> Mortgage investors (suppliers of mortgage funds) will, if they are risk averse, adjust their portfolios as the risk on the asset is reduced by increasing the amount of funds held in mortgage obligations. As this occurs, the quantity of mortgage funds supplied at any rate of effective interest will be increased and, with a downward sloping demand schedule for mortgage funds, the effective interest rate on mortgage obligations will be bid down until the decrease risk is compensated for by a decreased rate of return and the adjustment process is complete.

The resulting model is depicted in Figure 2.1. Here,  $D_j$  is the demand schedule for mortgage funds;  $S_j(I)$  is the supply of mortgage funds expressed as being dependent upon the provision of default insurance,  $I$ ;  $D_H(P_j)$  is the demand schedule for housing services expressed as a decreasing function of the price of housing,  $P_H$ , and the price of mortgage funds,  $P_j$ ; and  $S_H$  is the supply schedule for housing services. The provision of default insurance, a change from  $I^0$  to  $I^1$ , results in an increased supply of mortgage funds, a reduction in the effective rate of interest from  $P_j^0$  to  $P_j^1$ , an increase in the demand for housing services from  $D_H(P_j^0)$  to  $D_H(P_j^1)$ , and a consequent increase in the quantity of housing services produced and consumed.

In addition to the effect generated by the direct reduction in default risk on mortgage loans brought about by the insurance coverage

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<sup>8</sup>This effect will be treated more rigorously in Chapter IV of this study.



- Figure 2.1. Relationship Between the Provision of Insurance, the Supply of Mortgage Funds, and the Demand for Housing

provided by FHA, several related occurrences were taking place simultaneously that exerted an upward pressure on the demand for housing services at that time. First, the development of a national secondary mortgage market operated to increase the liquidity of the mortgage instrument as a financial asset and attract new sources of investment funds into the mortgage market. This development was facilitated by: (1) the trading activities of the Federal National Mortgage Association; (2) the application of FHA's Minimum Property Standards to insured loans (Foard and Frantz, 1973, p. III, 16); (3) competent, objective appraisals of the properties securing insured loans; and (4) the trend toward standardization of the mortgage instrument. Also, the liberalization of mortgage financing terms made possible by the provision of default insurance coverage served to reduce the downpayment requirements (through increased loan-to-value ratios) and/or monthly payments (through increased terms to maturity) necessary to obtain and successfully retire a mortgage contract. In the highly simplified model sketched above, this effect would have to be translated into a reduction in the effective interest rate required on mortgage loans where the effective rate would be defined to incorporate the financing terms of the loan (Cassidy, 1972). Both of these developments operated to increase further the demand for housing services, thereby supporting the pure insurance effect of FHA.

Given this increase in the demand for housing services, some increase in the quantity of housing produced and consumed should be expected to have been forthcoming (unless, of course, the housing supply

schedule exhibited a price elasticity equal to zero).<sup>9</sup> Such an increase could only be accomplished through an increase in employment in the residential construction sector. Therefore, we conclude that the Section 203 insurance program should, on theoretical grounds, have been successful in generating increased employment in this sector of the economy and in increasing the nation's overall consumption of housing services.

#### Later Entrants into the Default Insurance Market

For the first decade following its origination, the FHA Section 203 program remained the sole supplier of default insurance coverage for home mortgages. During that period, any potential mortgagor requiring (or preferring) a high ratio, long maturity loan turned to FHA for the insurance protection that the mortgagee was likely to require on such a loan. Since that time, however, several alternative suppliers of mortgage default insurance have entered the market exerting varying degrees of competitive pressure on the Section 203 programs. Such pressure has been provided by: (1) the creation of the Veterans Administration program providing home loan guarantees to eligible veterans; (2) the re-emergence and growth of the private mortgage insurance industry; and (3) the introduction of subsidized single-family housing and mortgage insurance programs within the FHA system. The creation and growth of these three basic alternative sources of default

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<sup>9</sup>For a review and evaluation of the current state of knowledge concerning the price elasticity of housing supply see Sneed (1974). As might be expected, no estimates of this elasticity are equal to zero. At the same time, however, none of the models utilized in obtaining these estimates is completely satisfactory (Sneed, 1974).

insurance coverage have greatly affected the post-war evolution of the mortgage insurance market. Consequently, they have influenced the experience of the Section 203 program over this period. We now discuss each of these later entrants.

With the intention of aiding the post-war adjustment of returning veterans to civilian life through the provision of housing credit assistance, the Congress, in 1944, enacted the Servicemen's Readjustment Act. This act authorized the Veterans Administration to guarantee lenders against default loss on home mortgages made to eligible veterans. These guarantees serve essentially the same purpose as the FHA insurance coverage--they reduce the default risk on the mortgage and, thereby, encourage lenders to increase the supply of mortgage funds. There are, however, several features that distinguish the VA home loan guarantee from FHA mortgage insurance. First, the VA guarantee is only available to eligible veterans, where eligibility is defined by legislative decree. The requirements imposed for such eligibility have been altered several times over the years in order to admit veterans of later conflicts and to prolong the period during which the individual veteran remains eligible to exercise his option to purchase a home under the program. The number of individuals having the option to insure their loans under the VA guarantee program has, therefore, fluctuated over time with variations in the number of persons leaving the armed services and with variations in the eligibility requirements of the program. Second, the coverage provided to the mortgagee under the VA guarantee program is less than 100 percent. It, therefore, provides default loss protection on a coinsurance basis, with the lender remaining exposed to some degree of risk. The coverage

provided for in the act, however, stipulates that the Veterans Administration absorb the lesser of 50 percent (later raised to 60 percent) of the outstanding balance on the loan or \$2,000 (raised to \$4,000 the following year and increased several times hence) before the lender begins to experience a loss. Thus, by providing coverage on the top portion of the loan (as opposed to a deductible or a percentage loss sharing), the VA guarantee does provide complete insurance coverage unless the property securing the loan experiences a very severe depreciation in value. Consequently, the coverage provided exposes the lender to very little actual risk.<sup>10</sup> Third, the Veterans Administration collects no insurance premium for the guarantee service (although for a three year period in the late 1960's a single origination fee of one-half of one percent of the loan was levied). Therefore, the VA form of default insurance is subsidized, being provided at zero cost to the eligible mortgagor. Fourth, the financing terms available on the VA-guaranteed loan are generally more liberal than those on FHA-insured mortgages. Loan-to-value ratios are quite high, often approaching 100 percent (indeed, in some instances they have exceeded 100 percent of the actual value of the property and have allowed the mortgagor to borrow most of the real estate closing costs, sometimes placing as little as \$200 equity in the loan). Also, there is no ceiling placed on the size of the mortgage eligible for the guarantee (although the limitation placed on the size of the potential insurance claim

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<sup>10</sup> Coverage of the top X percent of the mortgage loan may be virtually equivalent to complete (100 percent) coverage if the lender's subjective probability distribution over percentage default losses on the loan places a near-zero probability on the event that default loss will exceed X percent. In such a situation, the additional coverage provided on FHA-insured loans may be of little value.

discourages lenders from originating extremely large mortgages under this program). Like FHA, the VA guarantee program stipulates the maximum rate of interest that may be charged on the mortgages that they insure, and these rates are altered from time to time to reflect market conditions (although, at times, these rates have departed considerably from those charged on uninsured mortgages).<sup>11</sup>

The second source of competitive pressure exerted on the FHA Section 203 program has been the re-emergence of the private mortgage insurance industry. The first firm to enter this industry since the collapse in the early 1930's was the Mortgage Guaranty Insurance Corporation which began operations in 1957 in the state of Wisconsin. Since that time, the volume of insurance written by the private mortgage insurance industry has increased dramatically as new firms have entered, insurance reserves have accumulated, and as state laws forbidding the operation of private mortgage insurance companies have been relaxed to allow these firms to expand their market (the final state relaxing prohibitions against the activities of these firms was New York in 1973). The number of single-family units insured by the members of this industry moved from 12,484 in 1960 to 64,850 in 1965, 157,760 in 1971, and 505,180 in 1973.<sup>12</sup> A few declines have occurred in the volume of insurance written by these firms over this period, but such declines have generally coincided with declines in overall housing and mortgage lending activity. Presently, the number of companies in

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<sup>11</sup>Further information concerning the VA system of home loan guarantees may be found in Foard and Frantz (1973, pp. V, 47-74).

<sup>12</sup>Data provided to the author by Mortgage Insurance Companies of America, Washington, D. C., the trade association for the firms in this industry.

this industry is approximately 10, having declined somewhat in the last two years through merger activity that occurred in the early 1970's (Little, 1975, p. 121). The percent of the private market accounted for by the Mortgage Guaranty Insurance Corporation (the largest firm in the industry) has been steadily eroded over the years. It stood at 100 percent from 1957 until 1961; then, in the latter year, it declined to 93.76 percent. By 1965 it had fallen to 75.97 percent, and by 1970 it was down to 65.18 percent (Little, 1975, p. 122). This trend has continued into the 1970's with the 1972 market share falling to 60.00 percent and declining further in 1973 and 1974.

Although there have been no comprehensive studies carried out to determine the existing entry conditions in the private mortgage insurance industry, a recent examination that was designed to determine the adequacy of the contingency reserves of the major firms in this industry concluded that entry barriers were low (Little, 1975). This inference was made primarily from an examination of state regulations regarding paid in capital and contingency reserve requirements; and, therefore, the conclusion relates only to absolute barriers to entry (Bain, 1956). Given the recent growth experience in the number of firms in this industry, however, one must suspect that this conclusion is accurate of overall barriers to entry also (such as economies of scale, etc.). The industry may thus be described as a relatively young one that has been characterized by rather steady growth in both the size of the market and the competitive structure exhibited.

The typical default insurance contract marketed in this industry provides coverage of the top 20 percent of the outstanding balance on the loan and stipulates a premium rate of one-fourth of one percent of

this outstanding balance. Thus, both the coverage provided and the price charged on these contracts are lower than those under the Section 203 program; and, like the FHA program, neither the coverage nor the price has varied measurably over time.<sup>13</sup> Again, it is not clear how much risk the lender is exposed to under such a plan. For some loans, coverage of the top 20 percent may be considered as virtually equivalent to complete coverage (see footnote 10 above). Finally, the insurance contracts written by the firms in this industry place no ceilings on the size of the mortgage nor on the interest rate that may be applied to the loan.

The third and final major entrant into the default insurance market was the single-family subsidized housing and mortgage insurance programs that were incorporated in the FHA system by the National Housing Act of 1968. The largest of these has been the Section 235 program which combined direct housing subsidies with default insurance in order to increase homeownership among lower income households. Although this program was suspended in January, 1973, the volume of activity carried out under the subsidy programs during the brief period in which Section 235 was active is far from insignificant--the largest insurance volume occurred in the first quarter of 1972 when 33,240 new and 5,354 existing single-family units were insured. Eligibility for participation in these subsidy programs has been limited by household income with the ceilings varying by family size. Like the insurance written under Section 203, the coverage provided under this program has been 100 percent,

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<sup>13</sup>Several different payment schemes have been offered by these firms (without varying the basic rate) and, recently, a policy covering the top 25 percent of the mortgage balance has been introduced. For a detailed description of these aspects of the private mortgage insurance industry see Kohlhoss (1972) and Little (1975).

and ceilings have been placed on the mortgage size and allowable rate of interest. No premiums have been collected for the insurance service provided, however, and mortgagors received direct subsidization of mortgage payments under the program (Foard and Frantz, 1973, p. II, 4).

Thus, the monopoly situation initially enjoyed by FHA's Section 203 program has gradually disappeared. New firms and additional federal government programs have entered the default insurance market over time, and the competitive pressures exerted on this program have increased accordingly. The degree of substitutability between the coverage offered under the Section 203 program and these alternative sources of default insurance is not, however, immediately apparent. On an *a priori* basis, all that can be said is that some degree of substitution should exist between these various suppliers of default insurance coverage. Both the VA guarantee and the subsidy programs of FHA carry explicit eligibility requirements that reduce the direct substitution between these programs and Section 203 insurance coverage. To the extent that these programs provide insurance to individuals that would not have entered the housing and mortgage markets (and, hence, the mortgage insurance market), substitutability with Section 203 will be lowered (though probably not eliminated). In such a case, direct competition in the default insurance market is not generated, but increases in the volume of activity carried out under these programs may still reduce the demand for Section 203 coverage by the price effects generated in the housing and mortgage markets. That is, the increased demand exerted in these markets through increases in activity in the VA and subsidy programs should put upward pressure on mortgage interest rates and the price of housing services which, in turn, should reduce the

demand for Section 203 coverage. To the extent that these programs provide insurance coverage to individuals that would have otherwise purchased homes under the Section 203 program, however, substitutability will be increased since direct competition in the default insurance market will also be exerted (particularly since both of these programs provide coverage at subsidized rates). Finally, the degree of substitutability between Section 203 coverage and the insurance provided by the private firms in the market is also uncertain because of the market difference in the level of coverage offered (100 percent and 20 percent, respectively).

It is theoretically possible that the lower level of coverage provided by the private mortgage insurance firms generated an overall increase in the size of the default insurance market that has been approximately equal to the volume of insurance written by these firms; i.e., it is possible that the bulk of their business has been derived from previously uninsured loans. As was mentioned previously, however, it is also possible that the lower coverage provided by these firms is regarded by lenders as being only marginally more risky than the full coverage provided by FHA. If this has been the case, then competition between the private firms and Section 203 has been direct and the substitutability between these sources of default coverage has been large. Thus, the degree of substitutability cannot be inferred from theoretical considerations alone.

#### The Volume of Insurance under Section 203

The early history of the FHA Section 203 insurance program indicates that it was quite successful insofar as achieving a large volume

of activity and maintaining actuarial soundness. FHA-insured housing starts as a percent of total private housing starts moved from 6 percent in 1935 to 16 percent in 1936, 18 percent in 1937, and 30 percent in 1938 (Haar, 1960, p. 33). Volume of activity in terms of the number of mortgages on new units insured under the Section 203 program along with the total housing starts for the entire country (both insured and non-insured) in five year intervals for the 1935-1969 period is given in Table 2.1. From June, 1937, through November, 1957, \$17.003 billion in home mortgage insurance on new units and \$13.527 billion on existing units had been written under the Section 203 program. This volume of insured mortgages financed a total of 2,600,345 new and 1,980,783 existing housing units (Haar, 1960, p. 28).

Table 2.1. Privately Owned Housing Units Started under the FHA Section 203(b) Mortgage Insurance Program Compared with Total Housing Starts in the U.S.; 1935-69

| Years   | Total U.S. | Section 203(b) | Section 203(b)<br>as percent<br>of total |
|---------|------------|----------------|------------------------------------------|
| 1935-39 | 1,710,000  | 353,798        | 20.69                                    |
| 1940-44 | 1,772,700  | 388,731        | 21.93                                    |
| 1945-49 | 5,379,000  | 406,715        | 7.56                                     |
| 1950-54 | 7,708,000  | 1,094,970      | 14.21                                    |
| 1955-59 | 6,935,600  | 1,156,289      | 16.67                                    |
| 1960-64 | 7,160,000  | 894,535        | 12.49                                    |
| 1965-69 | 6,903,700  | 688,893        | 9.98                                     |

Source: Table 157 of the *1972 HUD Statistical Yearbook*, U.S. Department of Housing and Urban Development, U.S. Government Printing Office, Washington, D. C.

The actuarial soundness of this early business is evidenced in the fact that the initial funds borrowed from the U.S. Treasury in order to implement the FHA insurance system were repaid within a few years of operation. As of 1972, FHA's insurance reserves were over \$1.6 billion and the outstanding insurance in force on Section 203 loans amounted to almost \$103.2 billion (*Examination of Financial Statements Pertaining to Insurance Operations, Federal Housing Administration, 1972*). In spite of the continual liberalization of the financing terms on the mortgages insured, the Section 203 program has routinely and consistently met all insurance claims made against it, and by the middle of 1971, it had accumulated \$76 million in excess reserves beyond those required by actuarial computations (which, themselves, are estimated conservatively using the period of the 1930's as the base from which projected insurance claims are computed).

With regard to the more recent activities of FHA (over the decade of the 1960's and the early 1970's) no significant change is apparent if one examines only the total single-family activity (including Section 203 and the subsidy programs). Of the total mortgaged housing starts, FHA single-family programs insured 13.6 percent in 1966 and over 25 percent in 1971 with these starts representing approximately 129,000 units in 1966 and more than 300,000 in 1971 (Burgess, 1973, p. 1). If attention is focused, however, on the unsubsidized Section 203 program with which we are concerned in this study, a different picture emerges. Insurance activity under this program has declined considerably over the decade of the 1960's, and this decline has accelerated in the early 1970's. The volume of insurance written under this program in terms of the number of housing units insured per quarter is

given in Figures 2.2 and 2.3 for new and existing units separately for the 1960:1 through 1974:2 period.<sup>14</sup>

From these graphs, the decline in Section 203 insurance volume has obviously been more pronounced and continuous for policies written to cover mortgages on new units. Also, the decline appears to have begun earlier for this category of insurance. A plausible explanation for this observation lies in the private mortgage insurance firms' tendency to concentrate their activity on the insurance of mortgages written on new housing units (Semer and Zimmerman, 1975, p. 155). Such a tendency makes sense if default risk is generally lower on such properties since both the coverage provided and premium charged by these firms are below those of the Section 203 program.<sup>15</sup> For the present, however, this explanation of the observed difference in declines for Section 203 insurance written on new and existing units must remain at the speculative stage. The extant data on the insurance volume of the private firms in the industry do not separate activity by the type of property securing the mortgage. This shortcoming is typical of the overall housing and mortgage market data which, to a large extent, are generally unsatisfactory.<sup>16</sup>

In addition to the declining volume of insurance being written under the Section 203 program, significant increases have been

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<sup>14</sup>Calculated from monthly data in *FHA Monthly Report of Operations--Home Mortgage Programs*, RR:301 (Homes).

<sup>15</sup>Greater attention will be devoted to this issue in Chapter IV of this study.

<sup>16</sup>The literature relating to these markets is replete with references to the low quality and general unavailability of crucial data. Indeed, a complete time series on private mortgage insurance volume spanning a period since re-emergence of the industry did not exist prior to the one that I gathered for use in this study.

Dwelling Units (000)

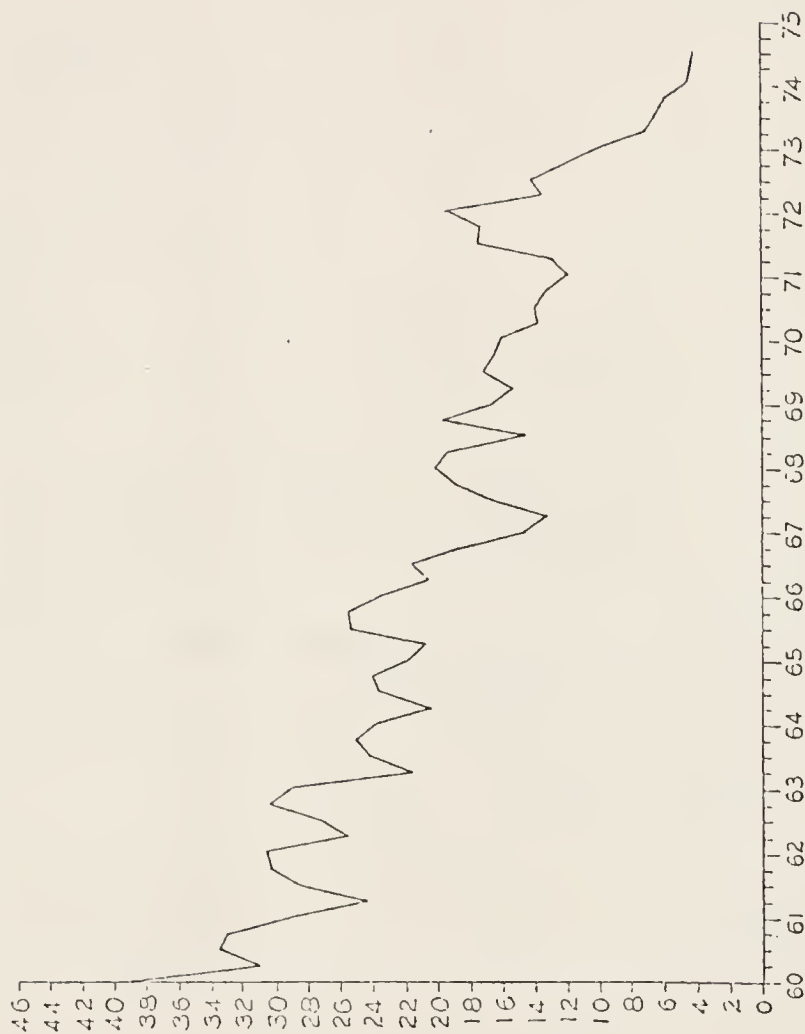


Figure 2.2. Number of New Single-Family Dwelling Units Insured under the Section 203 Mortgage Insurance Program; 1960:1-1974:2



Figure 2.3. Number of Existing Single-Family Dwelling Units Insured Under the FHA Section 203 Mortgage Insurance Program; 1960:1-1974:2

experienced in the average insurance loss per claim since 1971. If the current trend continues, the actuarial soundness of the program may become jeopardized at the current premium level. The present soundness of the insurance fund supporting this program may be largely attributable to past successes of the Section 203 program and interest earnings on past reserves ("Actuarial Briefing Paper," 1974).

Since FHA's Section 203 program was intended to function on an actuarially sound basis and since the program must cover certain non-variable costs (such as the maintenance of numerous insuring offices throughout the country) in order to continue its operations, it seems necessary that a certain volume of insurance activity be maintained if the program is to function on the basis envisioned by its enabling legislation. Therefore, the absolute number of mortgages insured under the Section 203 program is a crucial factor in the determination of FHA's future role in the unsubsidized single-family default insurance market, and it will be this measure of FHA activity to which our attention will be directed throughout this study.

Since this number is influenced not only by the competitive pressures exerted by new and growing entrants in the default insurance market, but also by the overall size of that total market (which, in turn, is influenced by the number of houses sold and mortgages originated), it is also of interest to trace the Section 203 market share over time. This is given in Figure 2.4 where market share is defined as Section 203 insurance volume divided by the sum of Section 203 insurance, VA insurance, private mortgage insurance, and FHA subsidized insurance volumes.

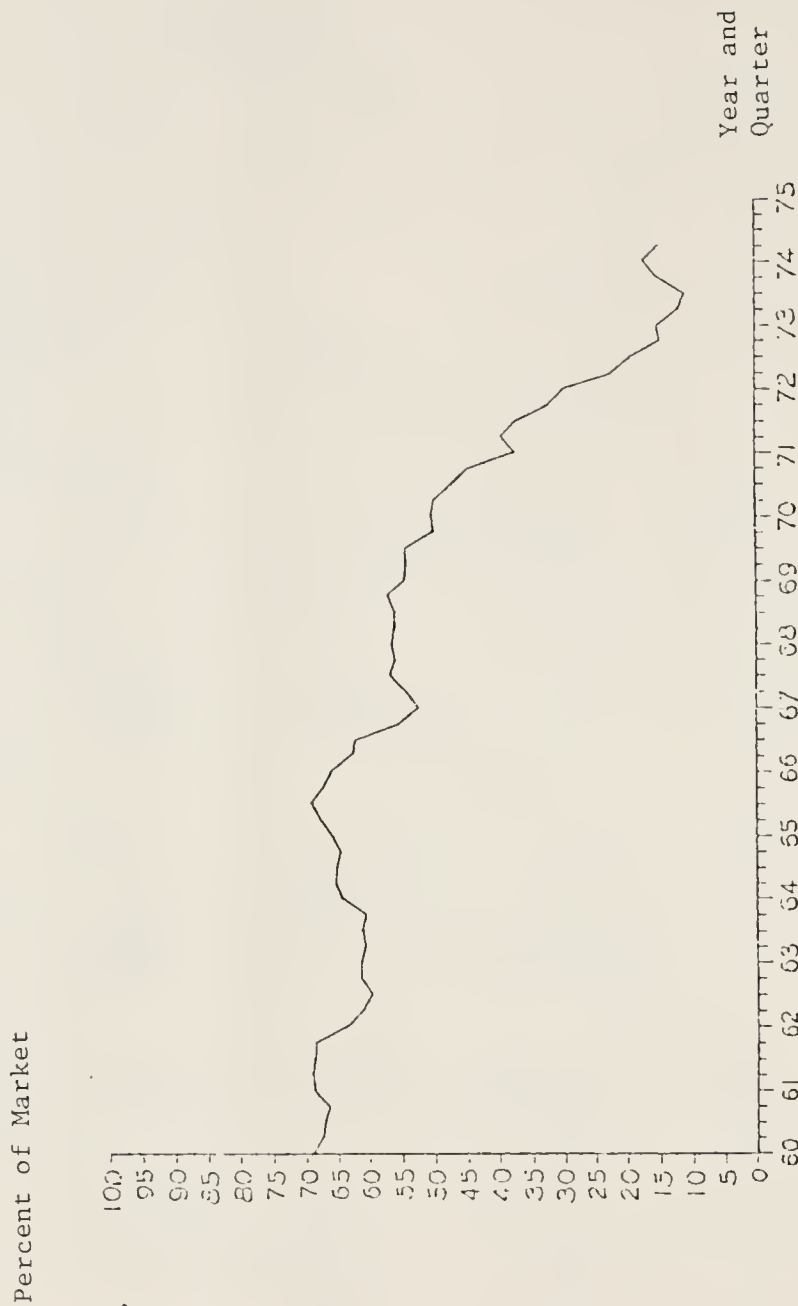


Figure 2.4. Share of the Default Insurance Market Accounted for by the FHA  
Section 203 Mortgage Insurance Program; 1960:1-1974:2

Clearly, the observed decline in the volume of activity under FHA's Section 203 program has not been generated solely or predominantly by decreases in the overall demand for mortgage insurance--particularly in recent years. Instead, the decline appears to have resulted, at least partially, from a loss of insurance volume to the competitive suppliers of default coverage. In order to be certain that this has been the case, however, we must investigate other factors that may have been significant contributors to this decline. And to do this, we must develop a more complete theory of the mechanisms involved in determining Section 203 activity over time. Before attempting to develop such a theory, however, it will be useful to present a brief review of some recent literature that will be employed in the construction of this theory.

### CHAPTER III LITERATURE REVIEW

#### The Scarcity of Relevant Literature

There have been no rigorous studies undertaken to ascertain the factors that have led to the observed decline in the volume of single-family unsubsidized insurance written by FHA. Naturally, over the last several years, various papers have emerged that have examined the decline in activity in a more or less logical fashion, usually focusing the reader's attention on one or, possibly, two factors that are characterized as "the" cause of shrinking volume.<sup>1</sup> These studies, however, typically fail to describe the causal mechanisms through which the hypothesized effect operates (i.e., the theoretical foundation for the conclusions that are reached is either implicit in the argument, or more often, totally absent). Also, the statistical techniques employed in these studies (in the rare instances in which empirical evidence is presented) generally fail to allow for more than one explanatory variable. Typically, a simple two-way table or graph is employed that reveals the time path of the volume of FHA activity and the time path of the hypothesized causal factor (Bazan, 1974, p. 9). Conclusions are then drawn from the contemporaneous movements of these two paths.

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<sup>1</sup>Examples of such studies include S. Baskin (1971), H. B. Bazan (1974), Booz-Allen and Hamilton Management Consultants (1973), C. L. Burgess (1973), A. Diamond (1973), J. B. Hedlund (1973), Mortgage Bankers Association of America (1971), R. L. Reppe (1973), J. L. Short *et al.* (1972), and B. Whitten (1973).

There is a danger of attributing cause to a spurious relationship with such techniques; and, even if the qualitative nature of the conclusion reached is correct, the policy maker is denied the parameter estimate that is crucial in the design of effective action. The causal factors collectively suggested in these papers, however, were not ignored in the analysis conducted in this study since, for the most part, they do receive theoretical support when closely examined.

In order to provide a background of the little economic literature that exists that is relevant to default insurance, the studies of George von Furstenberg and Henry Aaron will be described and critically evaluated in this chapter.<sup>2</sup> These studies are later employed as a starting point from which we derive a theory of the demand for mortgage insurance. This theory then provides a framework for the specification of an econometric model of the mortgage insurance sector from which inferences may be drawn concerning the causal factors that underlie the observed decline in FHA activity. Thus, while the analyses carried out by these two authors are not specifically concerned with the fall in FHA volume, they do provide a basis from which our study may proceed.

The works of Aaron and von Furstenberg received a cursory review in a recent paper by Greenston *et al.* (1974) that was published by the Urban Institute. While criticisms revealed in this paper are fundamentally sound, there exist several inaccuracies and exclusions that tend to detract from the discussion somewhat. These will be briefly mentioned in this chapter, but a great deal of attention will not be

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<sup>2</sup>These works include Aaron (1972), von Furstenberg (1969), von Furstenberg and Green (1974), von Furstenberg (1970a) and von Furstenberg (1970b).

devoted to them. Also, the brevity of the review provided in the Urban Institute paper leaves some confusion with regard to the methodologies employed in these studies which this chapter will attempt to clarify. Inasmuch as the basic conclusions reached in their review are correct, however, the findings in this chapter will not differ in any major respects. We turn now to the studies to be reviewed.

#### Studies of Default Behavior by von Furstenberg

George von Furstenberg has published a number of articles concerned with explaining and predicting default probabilities and expected default losses on home mortgages (see footnote 2). The model developed in each of these articles is empirical in nature with very little theoretical analysis of the default phenomenon. The units of observation employed in the statistical analyses are cohorts of FHA insured single-family mortgages. While there are some differences in the vector of exogenous variables incorporated in the estimating equations utilized in these studies (which may be attributable to the lack of a well developed theory), they are quite similar in the basic method employed and the important conclusions reached. Therefore, only the first of these studies will be reviewed in detail.

This paper, which appeared in the *Journal of Finance*, represents one of the first empirical examinations of the causal factors determining default risk on home mortgages that utilized multiple regression techniques. The purpose of the study was to develop estimating equations that could be employed to predict average default probabilities for groups of FHA insured loans in order to measure the intra-program transfers that arise under Section 203. As pointed out by

von Furstenberg, such transfers take place within the FHA insurance program because non-homogeneous risk classes are pooled within the Mutual Mortgage Insurance Fund of FHA and a single price is charged to all purchasers of the insurance coverage backed by this fund (i.e., the transfers arise as a result of a departure from an actuarially fair pricing scheme).<sup>3</sup>

Since the mortgages being examined are completely insured and since the insurance premiums do not reflect the relative default risks, the common technique of inferring the degree of risk on a financial asset from the relative interest rate paid cannot be employed. Instead, it is necessary to predict the expected default probability for a cohort of FHA insured loans (measured by the percentage of loans in the cohort that entered default status in a given year) from the basic financing characteristics of the loans in the cohort, especially with regard to the average loan-to-value ratio and term to maturity of these loans. While the actual mechanisms through which these characteristics influence default behavior are not made clear in the article, it is suggested that their effect on borrower equity is the connecting link.

The cohorts utilized in this study are defined by each combination of term to maturity, loan-to-value ratio, and classification of insured loans on the basis of the type of property securing the loans (new or existing). Then, through the use of the equations that are developed to predict the default probabilities of the individual cohorts, the author is able to make inferences concerning the risks on these loans

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<sup>3</sup>The important effects of this pricing system are dealt with in Chapter V of this study.

without reliance upon any financial market mechanisms (as might be reflected in interest rates or insurance premiums in the absence of FHA).

The discussion carried out by von Furstenberg in the following section of his paper seems to implicitly contain a loose-knit theory of default behavior on home mortgages. There is an obvious recognition of the importance of borrower equity in determining default probability and the role of financing variables in influencing borrower equity over time. But, a unified theory is never made explicit in this paper, nor does it appear in any of the others. One is tempted to conclude that von Furstenberg viewed the theoretical issues behind the discussion as being too obvious to warrant a rigorous, detailed examination. But, when one considers the myriad of factors (financial, economic, and demographic) that could, theoretically, affect default probability (all acting and interacting to determine both the equity position of the borrower and his individual reaction to that equity position) and the logical channels through which these factors might operate, the absence of a more explicit theoretical treatment must be viewed with concern. It is this absence of a rigorous theoretical construct that detracts from the work done by von Furstenberg. And, as mentioned above, the apparent inconsistencies in the specifications of the estimating equations utilized in later studies probably arise as a result of this absence.

Since defaults on a group of mortgages originated at a given moment in time do not occur immediately but are spread over time, von Furstenberg attempts to fit this time path of defaulting loans employing the loan-to-value ratio on the given cohort as a variable that shifts the entire path up or down without altering the actual shape of

the time distribution of defaults. He then fits his estimating equation separately for twenty, twenty-five, and thirty year mortgages further separated by new or existing properties securing the loan. Such unpooled estimation is appropriate under the hypothesis that the structural coefficients of the relationship other than the constant term differ by term to maturity and property type. In this situation, a single regression using the pooled sample that attempts to incorporate these effects through the addition of simple dummy variables that allow only for intercept shifts will be clearly misspecified. By fitting separate equations, the hypothesis above may be tested, and the pooling decision made in accordance with the results. For this reason, the approach adopted by von Furstenberg in fitting the relationship initially using the unpooled samples seems reasonable. This yields a total of six regression equations.

*A priori* information concerning the shape of the time path for defaulting mortgages is employed to determine the functional form of the estimating equations. This shape is generally characterized by Figure 3.1. Defaults as a percentage of all loans originated in a given year tend to rise for the first three or four years and then fall fairly rapidly and approach the zero axis by the end of the eleventh or twelfth year. While the level of this curve fluctuates with the risk-related characteristics of the loan, this functional form is consistently found in actuarial studies of home mortgages and appears to be quite stable over time and over mortgage characteristics (D. L. Armstrong, 1973).

Von Furstenberg hypothesizes that, for a given term to maturity and a given type of property securing the loans (new or existing), a

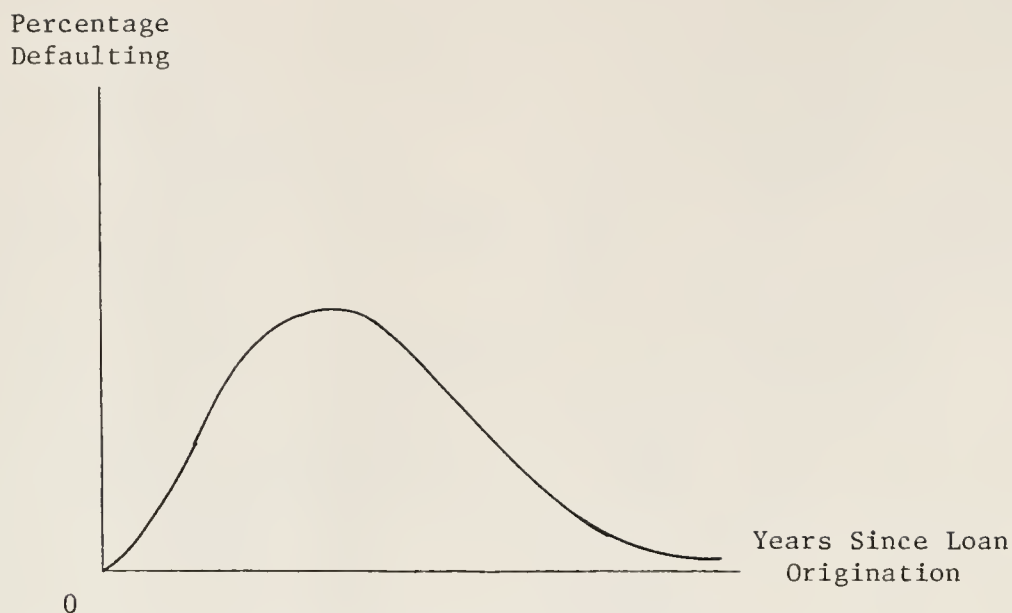


Figure 3.1. Time Path of Defaults on Home Mortgages

higher loan-to-value ratio for the cohort of mortgages will shift this curve upward leaving its functional form unchanged. Then, the skewed age distribution is represented by the natural exponential function

$$(D/E)_t = a_0 t^{a_2} e^{a_3 t^2}$$

where  $(D/E)_t$  is the percent of loans endorsed in a given base year that enter default status at  $t$  years after endorsement; and  $a_0$ ,  $a_2$ , and  $a_3$  are constants.

The variable that is used to capture the effect of the loan-to-value ratio is given by  $[10(1 - L/V)]$  where  $L/V$  is the loan-to-value ratio on the mortgage contract. It, therefore, measures ten times the percentage down payment on the loan. An explanation of why this particular transformation is employed is not given. Incorporating this as a shift variable in the above expression (affecting the position, but not the shape of the time path of default percentages), von Furstenberg writes

$$(1) \quad (D/E)_t = a_0 [10 (1 - L/V)]^{a_1} t^{a_2} e^{a_3 t^2}$$

from which he writes his estimating equation as

$$(2) \quad \ln (D/E)_t = \ln a_0 + a_1 \ln [10 (1 - L/V)] + a_2 \ln t + a_3 t^2 + u$$

Notice that, in this derivation, the disturbance term,  $u$ , is not included in the equation until after the logarithmic transformation has been carried out to characterize the relationship in a form that is linear in the parameters. The stochastic element mystically appears in an additive fashion. This econometric shell game is technically unappealing, but is often used. Obviously, the assumption that is implicit in this transformation is that equation (1) is actually given by

$$(1a) \quad (D/E)_t = a_0 [10 (1 - L/V)]^{a_1} t^{a_2} e^{a_3 t^2} e^u$$

where the stochastic part of the relationship (i.e., the distribution of  $(D/E)_t$  for given values of  $L/V$  and  $t$ ) is assumed (implicitly) to be log-normally distributed. Also, no evidence is given to demonstrate that the disturbance term in equation (2) is in accordance with the assumptions of the classical linear model that would assure the alleged properties of unbiasedness and efficiency from the ordinary least squares estimation technique that is employed.

Another technical shortcoming is found later in the paper when von Furstenberg pools new and existing units and incorporates a dummy variable to capture the effect of a different type of property securing the loan. Prior to this pooling, no formal test of a significant difference between the vector of coefficients estimated in the separate unpooled regressions is carried out (i.e., a Chow test). An initial examination of these coefficients (given in Table 1) indicates a rather

marked difference which implies that the effect cannot be characterized by a simple shift parameter that enters additively. If the slope coefficients themselves differ between the two groups, merely allowing an intercept shift will not correct properly for the effect. Consequently, such pooling may not be warranted. None of these econometric questions is mentioned in the Urban Institute review of von Furstenberg's analysis, but the basic lack of an explicit theoretical framework is duly noted.

The estimates obtained in the unpooled regressions are given in Table 1 from the original paper (von Furstenberg, 1969, p. 467). Given the apparent differences in the structural coefficients in these unpooled regressions, they are (in my own view) the preferred estimates. They are reported here only to indicate the qualitative impact of the loan-to-value ratio and term to maturity on default probabilities.

From these equations, von Furstenberg predicts default probabilities on cohorts of FHA-insured mortgages. Then, an attempt is made to transform these predicted probabilities into expected default losses by utilization of a weighting factor that is based upon the assumption that the insurer's loss, given the occurrence of default, will decline with the age of the mortgage.

In all, we stipulate that the insurer's loss per foreclosure declines with the age of the mortgage in default, but less than in proportion to the reduction in principle outstanding (von Furstenberg, 1969, p. 470).

This hypothesized relationship between default loss given foreclosure and time since origination is primarily founded upon conjecture, and it is not subjected to any empirical verification. A more rigorous approach would have strengthened the analysis considerably (perhaps

Table 3.1. Regressions of Default Rates on the Age (t) and Loan-Value (L/V) of Mortgages Grouped by Terms

| (A) "New" Home Mortgages      |                 |                   |         |                 |                   |         |
|-------------------------------|-----------------|-------------------|---------|-----------------|-------------------|---------|
| Term in Years:                |                 | 20                | 25      | 30              |                   |         |
| Variable Name                 | Regr.<br>Coeff. | (S <sub>a</sub> ) | t-Value | Regr.<br>Coeff. | (S <sub>a</sub> ) | t-Value |
| Intercept                     | -7.2553         |                   |         | -7.4260         |                   |         |
| 1 (1 - L/V)                   | -1.8613         | (.2871)           | -6.48   | -1.6373         | (.1639)           | - 9.99  |
| 2 t                           | .4094           | (.4302)           | .95     | 1.4544          | (.1975)           | 7.36    |
| 3 t <sup>2</sup>              | - .0290         | (.0180)           | -1.61   | - .0247         | (.0105)           | - 2.36  |
| r <sup>2</sup> (unadjusted)   | .1722           |                   |         | .3691           |                   |         |
| r                             | .4150           |                   |         | .6075           |                   |         |
| F-Value                       | 15.19           |                   |         | 65.71           |                   |         |
| D. of Freedom*                | 219             |                   |         | 337             |                   |         |
|                               |                 |                   |         | 142.62          |                   |         |
|                               |                 |                   |         | 345             |                   |         |
|                               |                 |                   |         | -5.6395         | (.0896)           | -18.37  |
|                               |                 |                   |         | -1.6464         | (.1102)           | 9.44    |
|                               |                 |                   |         | 1.0398          | (.0059)           | - 6.70  |
|                               |                 |                   |         | - .0395         |                   |         |
|                               |                 |                   |         | .5535           |                   |         |
|                               |                 |                   |         | .7440           |                   |         |
|                               |                 |                   |         | 142.62          |                   |         |
|                               |                 |                   |         | 345             |                   |         |
| (B) "Existing" Home Mortgages |                 |                   |         |                 |                   |         |
| Intercept                     | -5.9936         |                   |         | -5.3754         |                   |         |
| 1 (1 - L/V)                   | - .9877         | (.1293)           | -7.64   | -1.3148         | (.0460)           | -28.60  |
| 2 t                           | .9550           | (.1611)           | 5.93    | .5085           | (.0565)           | 9.00    |
| 3 t <sup>2</sup>              | - .0485         | (.0086)           | -5.64   | - .0275         | (.0030)           | - 9.10  |
| r <sup>2</sup> (unadjusted)   | .2157           |                   |         | .7252           |                   |         |
| r                             | .4644           |                   |         | .8516           |                   |         |
| F-Value                       | 31.89           |                   |         | 303.54          |                   |         |
| D. of Freedom*                | 348             |                   |         | 345             |                   |         |
|                               |                 |                   |         | -5.2139         | (.1050)           | -10.68  |
|                               |                 |                   |         | -1.1212         | (.1291)           | 4.53    |
|                               |                 |                   |         | .5852           | (.0069)           | - 7.48  |
|                               |                 |                   |         | - .0517         |                   |         |
|                               |                 |                   |         | .3415           |                   |         |
|                               |                 |                   |         | .5844           |                   |         |
|                               |                 |                   |         | 59.66           |                   |         |
|                               |                 |                   |         | 345             |                   |         |

\*The maximum number of observations in each run is 352 (32 annual default cells times 11 L/V's), but cohorts containing less than 40 mortgage endorsements were excluded.

employing individual mortgages as the units of observation and applying a Tobit analysis to predict both the probability of default and expected loss given default).

Incorporating the weighting factor that is postulated on the basis of this assumption, von Furstenberg reaches the following conclusions that are in basic agreement with the theoretical model developed in the following chapter of this study:

1. Expected default loss is directly related to the loan-to-value ratio on the mortgage contract; and
2. Expected default loss is also directly related to the term to maturity on the mortgage contract

These qualitative results are strengthened in the following chapter by addressing the default probability--expected loss issue from a purely theoretical point of view. They are then incorporated with a theoretical analysis of the loan contracting process that is developed as an extension of the descriptive treatment provided by Aaron in his analysis of the effect of default insurance on this process. Together, these will provide the basic variables for a demand for FHA insurance equation that can be more fully specified by the addition of product differentiating factors and that can be imbedded in a set of behavioral equations depicting the market for default insurance on home mortgages. We now turn to a review of Aaron's work.

#### Aaron's Analysis of the Contracting Process on Mortgage Loans

Henry Aaron's analysis of the effect of FHA insurance on the contracting process that takes place in the mortgage market between the

borrower and the lender is contained in his book, *Shelter and Subsidies: Who Benefits from Federal Housing Policies* (1972). The book itself deals with all of the major housing-related programs and policies carried out by the federal government (including incentives provided for homeownership through the income tax system). These are described in adequate detail to provide the reader with an understanding of the important functions of each, and estimates of the benefits derived by income class are attempted in order to identify the direction of the major redistributive effects. The default insurance and loan guaranty operations of FHA and VA are discussed in Chapter V.

The first part of the chapter briefly describes FHA's Section 203 program and the system of VA loan guarantees, providing some historical perspective for them. The second section (which is the one of primary interest here) develops an analytical model of the tradeoffs that exist and the negotiations that occur between the mortgagee and the mortgagor in arriving at a mutually agreeable contract and the influence that the provision of default insurance will exert on the outcome. The last section of the chapter provides estimates of the benefits derived by mortgagors from the provision of such insurance for various income classes separately for FHA and VA borrowers (this section drawing heavily from the empirical work of von Furstenberg discussed above). The review here will focus on the borrower-lender model developed in the second section.

The model portrayed in this section is graphical and descriptive in nature with very little explanation provided for the relationships hypothesized to exist. The analysis is weak in several respects and these weaknesses result in a rather blatant misinterpretation in the

conclusion of the chapter. Nonetheless, the description provided of the contracting process provides an intuitively appealing framework from which a more rigorous treatment can be developed. It is cast within the framework of a two party bargaining model with loan contract terms (specifically, the downpayment and the interest rate) being the subjects of negotiation. Insurance coverage is entered exogenously. The model used is described by the following graph, adapted from Figure 5-1 of Aaron's (1972, p. 83) book.

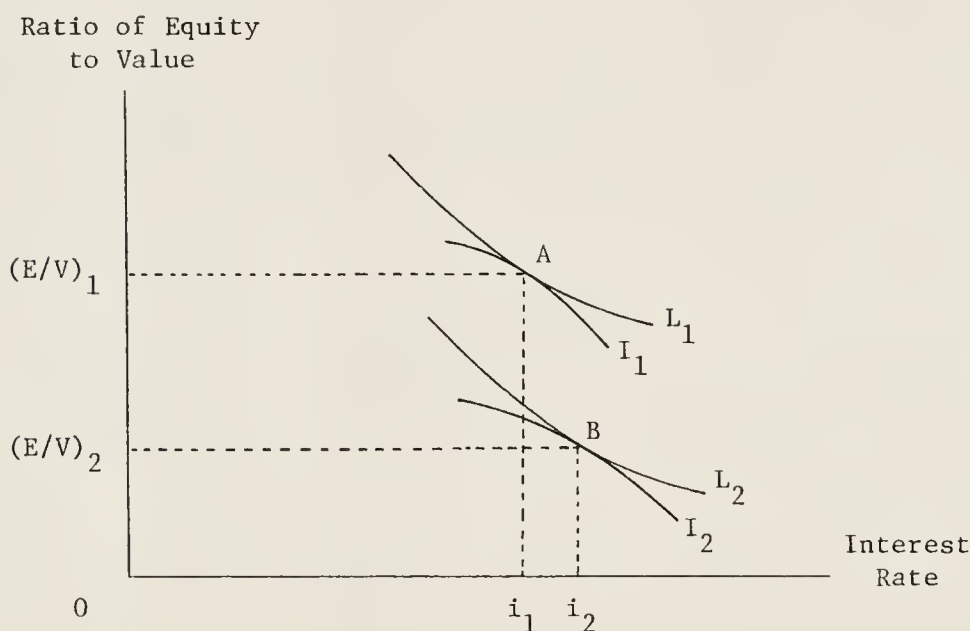


Figure 3.2. Lender and Borrower Tradeoffs Between Interest Rates and Downpayments

In this graph,  $(E/V)$  is the ratio of borrower equity to property value,  $i$  is the contract interest rate,  $L_1$  and  $L_2$  are lender indifference curves, and  $I_1$  and  $I_2$  are borrower indifference curves. The lender is described as deriving increased utility from higher interest rates (as higher rates increase profits) and from increased borrower equity (as

increased equity decreases expected default loss). The borrower is described as deriving increased utility from a reduction in either of these terms as such a reduction decreases the required downpayment and the price of the borrowed funds. Although Aaron describes the indifference curves in this graph as representing the utility functions of the borrower and the lender, it is clear that they must, instead, be interpreted in terms of indirect utility functions since neither actual profits (for the lender) nor real goods (for the borrower) are captured in the graph. Ideally, one would describe a utility of profits function for the lender and a utility of real goods (including future goods) function for the borrower, derive indirect utilities as functions of loan contract terms, and incorporate these into the bargaining model with which Aaron begins. Also, the convexity of the lender and the concavity of the borrower indifference curves in Figure 3.2 are not formally defended in Aaron's analysis, but instead, they are merely drawn as exhibiting these properties.

Default insurance is introduced by arguing that

Lenders are willing to accept more liberal terms when loss protection is available than when it is not because it enables them to avoid the risk of large loss from unusually frequent or costly foreclosures. Furthermore, loss protection insulates lenders from losses due to such unpredictable events as increased unemployment, declines in property values, or slowdowns in economic growth (Aaron, 1972, p. 82).

This argument is translated in terms of Figure 3.2 by asserting that curve  $L_1$  indicates the most liberal combinations of interest rates and downpayment requirements at which lenders will make loans if no loss protection is available, and that curve  $L_2$  indicates the most liberal combinations that lenders will accept if they are protected from default loss. Although Aaron does not make it explicit in his analysis,

the implication is that the level of utility along  $L_1$  is equal to the level of utility along  $L_2$  so that insurance protection is depicted in his model as a shift in the lender's indirect utility surface. With regard to the borrower's indirect utility function, however, no shift occurs so that the level of utility along  $I_2$  exceeds the level of utility along  $I_1$  in the graph. Thus, the equilibrium outcome of the negotiation process between the borrower and the lender shifts from point A to point B with the provision of default insurance with a resultant increase in borrower utility and constant lender utility. While it is not made clear in Aaron's analysis, the two points of equilibrium in the graph must be viewed as two of an infinite number of such points lying along the contract curve of the negotiating parties. Supposedly, some force is exerted from outside the negotiation process to determine which of these equilibrium solutions results--such as the tightness of the mortgage market existing at the time of negotiation. Insurance coverage also enters from outside since it is not pictured in the graph, and it too influences the equilibrium outcome.

Another point that should be mentioned that is ignored by Aaron is that the result pictured in the graph (a decrease in downpayment and an increase in interest rate) is solely a result of the actual utility functions underlying the indifference maps drawn. Given different lender and/or borrower preferences, the post-insurance equilibrium solution could easily result in the opposite movement (an increase in downpayment and a decrease in interest rate), or it could result in a reduction in both terms of the loan. The important point revealed in the graph is that, by providing the lender with default insurance, the borrower should be able to negotiate more favorable terms--a lower

downpayment for a given rate of interest or a lower interest rate for a given downpayment or some combination of these, depending upon the actual preference maps involved.

Overall, there are two fundamental weaknesses inherent in Aaron's analysis. First, the conclusions derived flow from the actual indifference curves drawn and basic underlying assumptions remain hidden in these curves (such as risk aversion utility functions for lenders). Second, the graphical approach forbids the direct incorporation of insurance coverage into the bargaining process and, therefore, leads to the complete exclusion of both the insurance premium and the lender's risk premium (both of which are crucial in the decision of whether to insure the loan). Since the insurance premium (which is just as much a cost to the borrower as higher interest rates or larger downpayments) is not incorporated in the graph, it would appear that all borrowers could increase their utility by providing the lender default insurance on the loan, and we would be led to expect all loans to be insured. Also, exclusion of the lender's risk premium results in a mistaken measurement of the benefits of the FHA insurance program--benefits are calculated as the difference between the expected default loss on the loan and the insurance premium paid with no consideration of lender risk premiums. Thus, many purchasers of FHA insurance are seen as deriving negative net benefits from participation in the program. Since insurance coverage is not forced upon anyone, one must ask why a rational consumer would willingly pay for a good that yielded benefits valued less than the price charged. Aaron's rationalization of this result is unconvincing.

Higher income households or those with low loans in relation to value received default protection worth less than the premium charged for it. It would appear that lending institutions could profitably offer such borrowers conventional loans with an interest charge greater than the current conventional rate but less than the FHA premium. Their failure to do so may reflect a judgment that in the absence of price inflation and attendant rises in property values, FHA home mortgage insurance would be severely underfinanced, perhaps by considerably more than 20 percent, so that virtually everyone would realize a net benefit under FHA mortgage insurance (Aaron, 1972, p. 89).

Such a global view on the part of lenders is questionable. Had Aaron incorporated the lender's risk premium into the analysis, such contortions would have been unnecessary. In fact, what Aaron interprets as borrowers' net benefits represents only the income redistribution taking place within the FHA program because of the non-actuarially-fair pricing scheme employed in supplying insurance coverage. With all purchasers of insurance coverage being charged the same premium, it is obvious that some will pay more than and some less than the expected default loss on their individual loans if the program is to break even. Such departures from the actuarially fair rate structure, however, do not fully represent borrower benefits; and such an interpretation must, by necessity, understate the real benefits derived from the insurance purchased. While Aaron does recognize the redistribution that occurs and the reason for its occurrence, he mistakenly identified this redistribution as the net benefits derived from the program because risk premiums are ignored.

The following chapter will adopt Aaron's basic approach by viewing the mortgage contracting process as a basic choice problem in which there exists tradeoffs among loan contract terms, interest rates, and insurance coverage. It will, however, extend the analysis by including

the term to maturity on the loan in the contract terms, explicitly considering the lender's risk premium, and deriving the conditions under which insurance will be desirable from the borrower's point of view.

CHAPTER IV  
A THEORETICAL MODEL OF DEFAULT RISK  
AND DEFAULT INSURANCE

Introduction and Overview of the  
Theoretical Model

The theoretical model developed in this chapter analyzes the default insurance market from both the demand side and the supply side in order to reach an understanding of the basic mechanisms involved in the determination of the quantities of insurance written. It is intended to explain both the overall market volume of insurance written and the individual volumes that are written by the various supply-side participants in that market. The model that is derived will be seen to differ from the standard microeconomic competitive market analysis in three important respects. First, the model incorporates uncertainty concerning mortgagor default behavior. Such uncertainty is, of course, the basic source of default insurance demand, and it is accounted for in the model by use of the state-preference approach to decision making under uncertainty. Second, the model explicitly introduces constraints of an institutional nature on the supply side of the market. These constraints have been particularly influential in the market for default insurance because of the importance of federal involvement and the intensity of state regulatory actions in this market. And third, the model recognizes the essential non-homogeneity of the insurance products supplied in this market. Such non-homogeneity results in a

segmented market structure that requires individual supply-side participants' behavior to be further constrained by the actions of other participants in the market (some of which exhibit behavior that is not motivated by profit considerations).

The model assumes that the default insurance market represents one sector of a larger three sector system consisting of the housing market, the mortgage market, and the default insurance markets. Together, these three sectors determine the quantity of houses sold, the quantity of mortgage funds loaned, and the quantity of insurance contracts written. It is further assumed that the housing and mortgage markets are determined simultaneously and that the default insurance market is determined recursively from the outcome of the equilibrating process occurring in the other two markets. One might imagine that the demand for and supply of housing services influences the demand for mortgage funds and that the demand for and supply of mortgage funds simultaneously influences the demand for housing services. Then, we assume that the demand for default insurance is determined from the demand for and supply of mortgage funds but that the outcome achieved in the default insurance market does not exert any simultaneous feedback effects on the housing and mortgage markets. This basic assumption concerning the structure of the larger three sector system is necessary if we are to examine the default insurance market in isolation without more detailed explicit modeling of the other two sectors.

The model also assumes that the home mortgage default insurance market is itself determined by the actions of three sets of participants: the mortgagor, the mortgagee, and the supplier of default insurance coverage. The first two sets of these participants interact in what is

viewed as a competitive mortgage market under conditions of default loss uncertainty to determine the market demand for mortgage default insurance. Thus, the model explicitly recognizes the derived nature of the demand for default insurance coverage where the primary source of this demand is found in the demand for and supply of mortgage funds. The relevant behavior of these two participants is explored in the two sections of this chapter that follow this introductory section.

The final set of default insurance market participants (the suppliers of default coverage) is composed of four major actors: the FHA Section 203 program, the private mortgage insurance industry, the Veterans Administration home loan guarantee program, and the FHA subsidized housing and mortgage insurance programs. Of these four actors, the last three are assumed to be subject to supply constraints of an institutional nature which result in their services being rationed on the basis of non-price characteristics. For the VA and FHA subsidy programs, the characteristics that are used to ration the services provided are the prior military service and the family income of the insurance applicants of the two programs, respectively. For the private mortgage insurance industry, the objective of maximizing profits subject to the constraints faced in this market (regarding both the quantity that may legally be written given the state laws forbidding entry and the regulations concerning maximum contingent liabilities that may be assumed and the price that may practically be charged given the presence of a supply schedule for Section 203 coverage that is infinitely price elastic) dictates that the service be rationed according to the default risk exhibited on the individual contracts. This mode of behavior on the part of the private mortgage insurance

industry implies cream-skimming from the previous customers of the Section 203 program.

Finally, the coverage supplied by the various actors in the market is considered to be non-homogeneous but substitutable. This implies a segmented market structure and results in the overall mortgage default insurance market being determined from the operations of four inter-related submarkets (one for each supplier of coverage). And, since neither cream-skimming nor rationing may occur in a competitive market in long run equilibrium, the model must be interpreted as short run in nature. We now derive a theoretical construct that will allow us to incorporate these complexities in our analysis of the home mortgage default insurance market.

#### Default Probability and Expected Default Loss on Individual Mortgage Loans

Since the fundamental purpose of mortgage insurance is to reduce the lender's exposure to default risk on insured loans, a theoretical analysis of default behavior provides a logical first step in the development of a comprehensive theory of default insurance. At this preliminary stage of the analysis, we are not concerned with the default insurance market itself, but rather, with the mode of behavior that gives rise to the phenomenon of mortgagor default. An understanding of such behavior will prove useful in later stages of the analysis when the demand side of the default insurance market is approached. The factors that are important in the determination of default risk on individual mortgage loans will influence the demand for insurance coverage on these loans and, as a result, will affect the overall market for default insurance.

As pointed out in the preceding chapter, the existing body of economic literature contains very little explicit theoretical analysis of mortgage default risk, although a considerable amount of empirical research has been conducted in this area.<sup>1</sup> Therefore, in the development of a theory of default insurance, it will be useful to first examine the mortgage default phenomenon from the perspective of economic theory. This section attempts to analyze default behavior from such a perspective. The basic purpose is to present the phenomenon of default on home mortgages as the logical outcome of a rational decision process that is influenced by certain observable factors.

The model of individual default behavior developed in this section utilizes the following notation:

$X_t$  = the individual's net assets other than the mortgaged property in period  $t$ ;

$I_t$  = the individual's income net of consumption expenditures in period  $t$ ;

$V_t$  = the market value of the mortgaged property in period  $t$ , seen as a random variable with density function  $f_t(V_t)$ ;

$r$  = the contractual interest rate on the mortgage obligation, constant over all  $t$ ;

$M_t$  = the mortgage balance outstanding in period  $t$ ;

$L/V$  = loan-to-value ratio on the mortgage at origination;

$D$  =  $1 - L/V$  = downpayment on the mortgage at origination expressed as a percent of the price of the house;

---

<sup>1</sup>Empirical studies that deal primarily with the estimation of default probability equations include: Baza and Kirzner (1975); Herzog and Earley (1970); Knight (1969); von Furstenberg (1969, 1970a, 1970b, 1970c, 1971, and 1974); and Williams *et al.* (1973). None of these studies, it should be noted, attempts to carry the empirical analysis to relationships explaining expected default losses which, from both the lender's and the insurer's point of view, are more relevant than simple probabilities of default.

$T$  = contract life of the mortgage obligation from origination to maturity; and

$g_t$  = probability of default on the mortgage obligation in period  $t$ .

Adopting this notation and ignoring, for the moment, any legal considerations raised by default, we may write the individual's wealth in period  $t$  (which we denote by  $W_t$ ) as

$$W_t = \begin{cases} X_t + I_t + V_t - (1 + r) M_t, & \text{with no default} \\ X_t + I_t, & \text{with default.} \end{cases}$$

If  $V_t$  were non-stochastic, it is obvious from this expression that the individual attempting to maximize wealth in period  $t$  would default on the loan if his equity in the mortgaged property became negative, where equity in period  $t$  (which we denote by  $E_t$ ) is given by

$$(1) \quad E_t = V_t - (1 + r) M_t.$$

This result, however, must be amended in light of the effect that defaulting on the mortgage will have on the individual's future ability to borrow funds. Credit ratings are based (at least, to some extent) upon past behavior in paying debts. This means that the individual will have to weigh the gain in utility from increased wealth brought about by defaulting in a negative equity situation against the loss in utility brought about by a decrease in future access to capital markets that is generated by such behavior. Consideration of this factor means that  $(1 + r) M_t$  will have to exceed  $V_t$  by a sufficient amount to compensate the individual for this decline in his ability to borrow funds before default will occur. This amount will vary over individuals, and for a given individual, it may vary over time. We may, however, assume

it to be constant for a given individual at a given moment in time. So doing, we denote this value by  $C_t$ , which represents the value of the individual's credit rating to him at period  $t$ . Certain demographic characteristics found entering the various regression equations of default probability studies may be seen to function through this factor, i.e., individuals with particular characteristics (race, age, income, etc.) may value credit ratings higher or lower than others in a systematic fashion.

With  $V_t$  still assumed to be known with certainty, the equity/default probability relationship can be described as

$$E_t + C_t > 0 \quad \text{implies} \quad g_t = 0$$

$$E_t + C_t < 0 \quad \text{implies} \quad g_t = 1.$$

Here, we have the case where a slight decline in  $V_t$  below  $(1 + r) M_t$  does not result in default on the loan because the small gain in the mortgagor's wealth position does not warrant the damage that will be done to his credit rating by defaulting on the loan. The individual may be perfectly willing to suffer negative equities if he places sufficient value on his future access to capital markets. Consideration of the myriad factors that may, theoretically, influence  $C_t$  is beyond the scope of this analysis, but it seems clear that such factors may be very important in determining individual default behavior.<sup>2</sup>

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<sup>2</sup>Transactions costs involved in selling a house would have the opposite effect of  $C_t$  and could make default the optimal choice even in a positive equity situation if sufficiently large. Assume that the individual must relocate and is forced to terminate the mortgage obligation in order to be able to afford housing in the new location. His choice, then, is whether to sell the house and successfully retire the loan or simply default on the mortgage. Denoting transactions costs involved in selling by  $Z_t$ , default will be optimal if  $V_t + C_t < (1 + r) M_t + Z_t$ . Therefore, even if  $V_t > (1 + r) M_t$ , default may still be optimal

$V_t$ , however, is not known with certainty. The value of the mortgaged property is subject to fluctuation as a result of changes in various factors beyond the control of either the mortgagee or the mortgagor. For example, the construction of a new highway through the neighborhood containing the mortgaged property may be announced; an adjoining neighborhood may be re-zoned; or the local or national economy may experience an economic downturn. All of these occurrences will affect the market demand for the property securing the loan and, therefore, influence the value of that property. In order to capture the effect of these various factors in the model, we assume  $V_t$  to be a random variable with a probability density given by  $f_t(V_t)$ . Since it appears likely that the probability distribution of the value of the mortgaged property will vary over time, we allow for the possibility that the density functions,  $f_t(V_t)$  will differ for different time periods. In particular, changes over time in the conditions of the neighborhood, the property, or the local housing market will affect the functional form of  $f_t(V_t)$ .

We now define  $V_t^*$  as the value of the mortgaged property in period  $t$  at which  $E_t$  plus  $C_t$  becomes zero, i.e.,

$$(2) \quad V_t^* = (1 + r) M_t - C_t .$$

Then, the individual's expected wealth in period  $t$  (denoted by  $E[W_t]$ ) can be written as

if  $Z_t > C_t$  by a sufficiently large amount. This factor, however, is likely to be fairly constant over individuals and over time. Consequently, we do not incorporate it explicitly in the theoretical model, although such incorporation could be easily adopted if the model were being developed for more specific purposes than those here.

$$(3) \quad E [W_t] = \int_{-\infty}^{V_t^*} [X_t + I_t] f_t(V_t) dV_t \\ + \int_{V_t^*}^{\infty} [X_t + I_t + V_t - (1+r) M_t] f_t(V_t) dV_t$$

where the first integral on the right-hand side represents the individual's wealth position if the value of the mortgaged property becomes sufficiently low to make default the optimal (expected wealth maximizing) policy and the second integral represents the individual's wealth position if the value of the property remains sufficiently high to warrant continuation of the mortgage payments. If one felt it desirable to assume that property values remain non-negative, the lower limit of integration for the first integral on the right-hand side of equation (3) could be replaced with the value zero. Such an assumption, however, is not required for our purposes so we maintain the more general expression above.

Maximization of this expected wealth requires that the individual default on the loan as soon as  $V_t$  declines to  $V_t^*$ . Given our definition of  $V_t^*$  in equation (2) above, we know that the probability of default in period  $t$  is given by

$$(4) \quad g_t = \Pr [V_t \leq (1+r) M_t - C_t].$$

Then, by definition of a cumulated distribution function we know that

$$(5) \quad g_t = \int_{-\infty}^{(1+r) M_t - C_t} f_t(V_t) dV_t.$$

This expression reveals the channel through which neighborhood and property characteristic variables found in many of the default probability studies may be seen to function.<sup>3</sup> By affecting the time path of property values (hence,  $f_t(V_t)$ ), these factors influence default probabilities both in the present period and in future periods. Housing market disruptions created by local or national recessions can also be seen to function through this channel. For example, the distributions  $f_{t+i}(V_{t+i})$ ,  $i = 1, \dots, n$ , may all be shifted to the left (i.e., the expectation of future property values may be reduced) by an exogenous occurrence such as the decay of the neighborhood in which the mortgaged property is located, thus increasing the probability of default in the present and all future periods.

For a given distribution of values for the mortgaged property at time  $t$  (i.e., given  $f_t(V_t)$ ), equation (5) implies that

$$(6) \quad \frac{\partial g_t}{\partial M_t} > 0 ,$$

$$(7) \quad \frac{\partial g_t}{\partial C_t} < 0 ,$$

and

$$(8) \quad \frac{\partial g_t}{\partial r} > 0 .$$

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<sup>3</sup>Given that default probability bears such a close relationship to the density function of property values, the phenomenon of redlining may be explained as a divergence between lenders' subjective notions concerning  $f_t(V_t)$  in future periods and the housing market's capitalization of these future values into the selling price of the property. To the extent that expected future declines in the price of a house are not capitalized into the selling price, lenders will be unwilling to make loans on the house.

Intuitively, for a given probability distribution of property values, the greater the outstanding mortgage balance,  $M_t$ , the greater will be the probability that  $V_t$  will decline to  $V_t^*$  and, as a result, the greater will be the probability that the mortgagor will default on the loan,  $g_t$ . The inequality in expression (7) merely illustrates the obvious point that the greater the value that the mortgagor places on his credit rating,  $C_t$ , the lower will be the probability of default,  $g_t$ . And, the result given in (8) indicates that default probability will be directly related to the contract interest rate,  $r$ . This last finding stems from the reduction in owner equity at any given moment in time that results from higher interest rates. For the moment, we focus our attention on the relationship in expression (6).

Given the interest rate and the price of the mortgaged property (denote this price by  $P$ , where  $P = V_t$  at  $t = 0$ ), the important elements in determining the time path of the outstanding mortgage balance are the percentage downpayment,  $D$ , and the contract life of the mortgage,  $T$ . If we ignore interest charges and assume a constant, even reduction of the principal on the loan, the outstanding balance in period  $t$  may be written as<sup>4</sup>

$$(9) \quad M_t = P(1 - D) - t[P(1 - D)/T], \quad t = 0, \dots, T.$$

The first term on the right-hand side is the original mortgage amount, and the second term is the cumulative amount of the loan that has been

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<sup>4</sup>Today, most mortgage loans exhibit constant, level payments, which this formulation does not. The formulation for the outstanding balance on such loans, however, is much more complex and utilizing it does not alter the qualitative results; therefore, the simpler approach is adopted.

paid by the borrower at time  $t$ . Obviously,  $M_t > 0$  for all  $t$  except the last (when  $t = T$ ) in which case  $M_t = 0$  and the mortgage is retired.

From this expression we see that

$$(10) \quad \frac{\partial M_t}{\partial D} = -P + t \frac{P}{T} < 0 \quad \text{for } t = 0, \dots, T-1$$

$$= 0 \quad \text{for } t = T,$$

and

$$(11) \quad \frac{\partial M_t}{\partial T} = t \frac{P(1-D)}{T^2} > 0 \quad \text{for } D < 1$$

$$= 0 \quad \text{for } D = 1.$$

These results indicate the qualitative relationship between the outstanding mortgage balance in period  $t$  and the percentage downpayment (in expression 10) and term to maturity (in expression 11). For a given purchase price, this outstanding balance will be lower the larger the downpayment and the shorter the term to maturity.

Ignoring the special but uninteresting cases where  $\frac{\partial M_t}{\partial D} = \frac{\partial M_t}{\partial T} = 0$ , we may combine the above results via the chain rule and expression (6) to obtain the results that

$$(12) \quad \frac{\partial g_t}{\partial D} = \frac{\partial g_t}{\partial M_t} \frac{\partial M_t}{\partial D} < 0,$$

and

$$(13) \quad \frac{\partial g_t}{\partial T} = \frac{\partial g_t}{\partial M_t} \frac{\partial M_t}{\partial T} > 0.$$

These results stem from the effects of initial downpayment and term to maturity on the outstanding mortgage balance and through this, borrower equity. For a given loan at a given moment in time,  $M_t$  will be larger

(and, for a given  $V_t$ ,  $E_t$  will be smaller) the smaller is  $D$  and the larger is  $T$ .

The inequalities given in expressions (12) and (13) above describe the qualitative relationship between default probability and loan contract terms. Since the mortgagee's actual default loss (or the insurance claim on 100 percent insured loans) in the event that default occurs is (ignoring foreclosure and transactions costs) equal to the negative equity position of the mortgaged property, expected default losses will also be influenced by contract terms. If we let  $E[L_t]$  denote the expectation of default loss on the given loan in the given period and adopt the simplifying assumption that property values fluctuate in a continuous fashion<sup>5</sup> so that the mortgagor will default when the value of the mortgaged property equals  $V_t^*$  exactly, we have

$$\begin{aligned}
 E[L_t] &= - \int_{-\infty}^{V_t^*} [V_t^* - (1+r)M_t] f_t(V_t) dV_t \\
 &= -V_t^* \int_{-\infty}^{V_t^*} f_t(V_t) dV_t + (1+r)M_t \int_{-\infty}^{V_t^*} f_t(V_t) dV_t \\
 &= [-(1+r)M_t + C_t + (1+r)M_t] g_t \\
 &= C_t g_t.
 \end{aligned}$$

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<sup>5</sup>This assumption represents an obvious departure from descriptive reality. It is necessary, however, if we are to derive a precise expression for expected default loss under the assumption that mortgagors enter default at precisely the optimal point. To the extent that non-continuities forbid such behavior (through, for example, discrete jumps in the value of a given piece of property), our derived expression will understate these losses. The qualitative relationships that this assumption allows us to derive, however, will remain valid.

Obviously, under the assumptions that the mortgagor attempts to maximize expected wealth after taking the value of his credit rating into account and that property values vary continuously, default will occur as soon as negative equity in the property (given by the difference between  $V_t$  and  $(1 + r) M_t$ ) is equal to  $C_t$  in absolute value. Then, the actual loss to the lender in the event of default will always be equal to  $C_t$ , and expected loss is the actual loss times the probability of default occurring.

Thus, the expected default loss to the mortgagee depends upon the probability of default loss and the degree of negative equity that the mortgagor is willing to absorb to protect his credit rating. Recall, however, that this latter variable also influences  $g_t$  because it is included in our definition of  $V_t^*$  (expression (2) above). Also, recall that it bears a negative relation to  $g_t$  (expression (7) above), so that its net effect on  $E[L_t]$  becomes ambiguous. Intuitively, the greater the value that an individual places on his credit rating the lower will be the probability that default will occur but, in the event that it does occur, the larger the actual loss is likely to be. Such a result emphasizes the inherent weakness of limiting the analysis of default risk to the explanation of default probabilities.<sup>6</sup>

With regard to the terms on the mortgage contract, however, it is clear from the above expression that

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<sup>6</sup> Obviously, a similar result would have applied to  $Z_t$  had this factor been incorporated in the model. Here, transactions costs would tend to increase the probability of default but would (assuming that these costs are lower for lenders than for individuals because of possible scale economies, greater bargaining strength with brokers, etc.) tend to reduce actual losses in the event that default occurs.

$$(14) \quad \frac{\partial E [L_t]}{\partial D} < 0 ,$$

$$(15) \quad \frac{\partial E [L_t]}{\partial T} > 0 ,$$

and

$$(16) \quad \frac{\partial E [L_t]}{\partial r} > 0$$

for a given  $f_t(V_t)$ . That is, expected default loss is inversely related to the percentage downpayment (or directly related to the loan-to-value ratio), directly related to the term to maturity, and directly related to the contract rate of interest on the mortgage obligation. These are the basic qualitative relationships that will be employed in the following section of this chapter in examining the individual's decision of whether to borrow on an insured or an uninsured basis given the market rate available on the two types of loan. These results receive strong empirical support from the default studies of von Furstenburg and others. Therefore, no attempt is made to replicate these results in this study, and the reader is referred to the regression results presented in Chapter III above.

#### The Demand for Default Insurance Coverage

Recognizing the influence that financing terms have on default risk, we now consider the impact that such risk exerts on the individual lender's supply of mortgage funds and, through this, the market price (or rate of interest) on such funds. By focusing attention on the mortgage lender, we will be able to shed some light on the basic source from which the demand for mortgage default insurance is derived

(this source being the lender's aversion to default risk), and we will then be in a position to draw inferences concerning the important factors that are likely to determine this demand.

In so doing, it will be expedient to adopt several simplifying assumptions that constitute rather drastic departures from real world situations. An extended discussion of the methodological role of assumptions in the derivation of theoretical models is, obviously, beyond the scope of this study. Instead, we can merely express the opinion that the violence that is done to descriptive accuracy through the use of these assumptions does not jeopardize the usefulness of the conclusions that they enable us to obtain. Some of the basic assumptions that are employed in this section include:

1. Mortgage markets are workably competitive in the sense that individual lenders take prices (or interest rates) as given.
2. Mortgage lenders are viewed as suppliers of mortgage funds only.
3. Individual mortgage loans are viewed as marginal units to the lender (although, in reality, they differ in size).<sup>7</sup>

These three assumptions represent only the most basic and most obvious departures from reality that are embodied in the model below. Other somewhat less brazen assumptions will be adopted as the analysis proceeds.

The first conceptual difficulty that must be confronted in our analysis of lender behavior is that even within the confines of assumption 2 above, we must recognize the essential heterogeneity of

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<sup>7</sup>On the application of marginal analysis to non-continuous problems, see Friedman (1953, p. 15).

individual mortgage loans. Since the financing terms on individual mortgage loans vary considerably across such loans, and since these terms have been shown to influence default risk, our analysis should allow us to separate mortgages of distinct term-related risk levels. Because of this risk heterogeneity, there will not exist a single market price for mortgage funds; but instead, there will exist a market price vector for loans with different financing terms at any given moment in time. In this way, we can allow the market price of an individual loan to reflect the inherent default risk on that loan. To accomodate this essential feature in the model below, we apply the concept of commodity hierarchies (Sweeney, 1974) to the mortgage market. Specifically, we interpret default risk as a quality variable and assume  $k$  classes of loans that are distinguishable and mutually exclusive regarding the default quality (risk) exhibited. These classes are considered to be defined by the contract terms of the loans within the class; i.e., all 30 year, 90 percent loans are assumed to exhibit essentially identical default risk and are, therefore, classed together at one quality level. We also assume that individual lenders originate a large number of loans in each quality class so that the marginal analysis may be applied to individual classes of loans. Then, ranking these loan classes in ascending order of default risk (or alternatively, in descending order of loan quality) we may write the market vectors of loan prices ( $r$ ) and quantities ( $M$ ) as

$$r = [r_1 \dots r_k]$$

and

$$M = \begin{bmatrix} M_1 \\ \cdot \\ \cdot \\ \cdot \\ M_k \end{bmatrix}$$

where, through the operation of the market, we will see that the prices that are established will increase with the default risk exhibited, i.e.,

$$r_i < r_j \quad \text{for } 1 \leq i < j \leq k.$$

Also, by assumption, each class quantity,  $M_j$ , is formed by summation of  $n_j$  loans, each of which is reasonably equivalent with regard to the default risk exhibited, so that

$$M_j = \sum_{i=1}^{n_j} M_{ji},$$

and the total quantity of loans originated by the given lender in the given period will be

$$M^T = \sum_{j=1}^k \sum_{i=1}^{n_j} M_{ji}.$$

Then, the total revenue obtained by the lender will be

$$R = r M = \sum_{j=1}^k r_j M_j$$

and, obviously, with positive prices and  $r$  given to the firm,

$$\frac{dR}{dM} = r > 0.$$

Finally, in order to simplify the analysis, we assume that the time

period referred to in this section is defined by the maximum maturity of the loans originated so that the  $r$  vector will represent the percentage interest charges over the life of the various loan classes.

Given this conceptual framework, we turn to our analysis of lender behavior. In so doing, we adopt the following additional notation and assumptions.

$L^T = \sum_{j=1}^k L_j$  is the total default loss to the lender in the given period on all loans originated in that period. Assuming that total default loss increases with the quantity of loans originated and recalling the influence of loan contract terms on default risk, we may write the total default loss for each class,  $L_j$ , as a function of the quantity of loans originated in that class, the financing terms that serve to define the class, and a random variable,  $Z_j$ . So doing, we have  $L_j = L_j (M_j, (L/V)_j, T_j, Z_j)$ , where  $(L/V)_j$  is the loan-to-value ratio and  $T_j$  is the term to maturity that together define class  $j$  loans. Obviously,  $\frac{\partial L_j}{\partial M_j} > 0$ , and from the conclusions reached in the preceding section,  $\frac{\partial L_j}{\partial (L/V)_j} > 0$  and  $\frac{\partial L_j}{\partial T_j} > 0$ . Also, we assume that  $\frac{\partial^2 L_j}{\partial M_j^2} \neq 0$ .

$C^T = \sum_{j=1}^k C_j$  is the total cost of supplying mortgage funds that are unrelated to default risk. It includes administrative costs and the opportunity costs of the funds made available. It is seen as an increasing function of the quantity of loans originated, both in total and within loan classes, so that  $C^T = C^T (M^T)$  and  $C_j = C_j (M_j)$  where  $\frac{dC^T}{dM^T} > 0$  and

$\frac{dC_j}{dM_j} > 0$ . Also, assuming that these costs are independent of risk, we will have  $\frac{dC^T}{dM^T} = \frac{dC_j}{dM_j}$ .

Utilizing this notation, we may describe the profit function of the mortgage lending institution (assuming for the moment that none of the loans originated carry default insurance coverage) as

$$\pi^T = R - L^T - C^T$$

where  $\pi^T$  is the total profit for the given period which is given by the sum of the individual profits on each loan class,

$$\pi^T = \sum_{j=1}^k \pi_j.$$

Then, we may write total profits as

$$\sum_{j=1}^k \pi_j = \sum_{j=1}^k r_j M_j - \sum_{j=1}^k L_j(M_j, Z_j) - \sum_{j=1}^k C_j(M_j).$$

Due to the presence of the random variable,  $Z$ , in this equation, the lender's profits will be stochastic.

Assume that the lender possesses a utility of profits function that satisfies the von Neumann-Morgenstern axioms (see Horowitz, 1970, pp. 342-351). Let this function be given by  $U = U(\pi^T)$ , and let the function be defined over profits from individual loan classes,  $U_j = U_j(\pi_j)$ . Then, adopting the objective of expected utility maximization, we may write the lender's objective function as

$$(18) \quad E[U(\pi^T)] = E\left[U\left(\sum_{j=1}^k r_j M_j - \sum_{j=1}^k L_j(M_j, Z_j) - \sum_{j=1}^k C_j(M_j)\right)\right].$$

Differentiating this expression partially with respect to each of the lender's control variables (the  $M_j$ 's),

$$\begin{aligned} \frac{\partial E[U(\pi_j)]}{\partial M_j} &= E\left[\frac{\partial U}{\partial \pi_j} \left(r_j - \frac{\partial L_j}{\partial M_j} - \frac{dC_j}{dM_j}\right)\right] \\ &= E\left[\left(\frac{\partial U}{\partial \pi_j}\right) \left(r_j - \frac{dC_j}{dM_j}\right)\right] - E\left[\left(\frac{\partial U}{\partial \pi_j}\right) \left(\frac{\partial L_j}{\partial M_j}\right)\right], \\ j &= 1, \dots, k \end{aligned}$$

where  $\frac{\partial U}{\partial \pi_j}$  is the lender's marginal utility of profit from class  $j$  loans. Setting each of these  $k$  expressions equal to zero and simplifying, we obtain the first-order conditions necessary for the maximization of the expected utility of profits,<sup>8</sup>

$$(19) \quad r_j = \frac{dC_j}{dM_j} + E\left[\frac{\partial L_j}{\partial M_j}\right] + \frac{\text{cov}\left[\frac{\partial U}{\partial \pi_j}, \frac{\partial L_j}{\partial M_j}\right]}{E\left[\frac{\partial U}{\partial \pi_j}\right]}, \quad j = 1, \dots, k$$

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<sup>8</sup>Setting this expression equal to zero, we obtain

$$E\left[\left(\frac{\partial U}{\partial \pi_j}\right) \left(r_j - \frac{dC_j}{dM_j}\right)\right] - E\left[\left(\frac{\partial U}{\partial \pi_j}\right) \left(\frac{\partial L_j}{\partial M_j}\right)\right] = 0$$

or

$$\left(r_j - \frac{dC_j}{dM_j}\right) E\left[\frac{\partial U}{\partial \pi_j}\right] - E\left[\left(\frac{\partial U}{\partial \pi_j}\right) \left(\frac{\partial L_j}{\partial M_j}\right)\right] = 0.$$

Then, since the expected value of a product of two random variables is equal to the product of their expected values plus the covariance between these random variables,

$$\left(r_j - \frac{dC_j}{dM_j}\right) E\left[\frac{\partial U}{\partial \pi_j}\right] - E\left[\frac{\partial U}{\partial \pi_j}\right] E\left[\frac{\partial L_j}{\partial M_j}\right] - \text{cov}\left[\frac{\partial U}{\partial \pi_j}, \frac{\partial L_j}{\partial M_j}\right] = 0.$$

Dividing by  $E\left[\frac{\partial U}{\partial \pi_j}\right]$  and moving all negative terms to the right-hand side yields expression (19).

Assuming that the second-order conditions are met (i.e., that the lender is indeed maximizing the expected utility of profits), these expressions give the total interest charges that the borrower of class  $j$  loans will have to pay in order for the lender to be willing to originate the marginal loan in that class. The expressions implicitly define the lender's supply schedule of mortgage funds for each of the  $k$  loan classes.

We know (by assumption) that  $\frac{dC_j}{dM_j} > 0$  and  $E \left[ \frac{\partial L_j}{\partial M_j} \right] > 0$ . The third term on the right-hand side of the expressions given in (19) above are the covariances between the marginal utility of profits and the marginal default loss divided by the expectation of the marginal utility of profits. The denominators of these terms are assumed to be always positive (i.e.,  $U$  is assumed to increase monotonically) so the signs depend upon the signs of the covariance terms in the numerators. If the lender is risk averse,  $U(\pi_j)$  will be concave as in Figure 4.1.

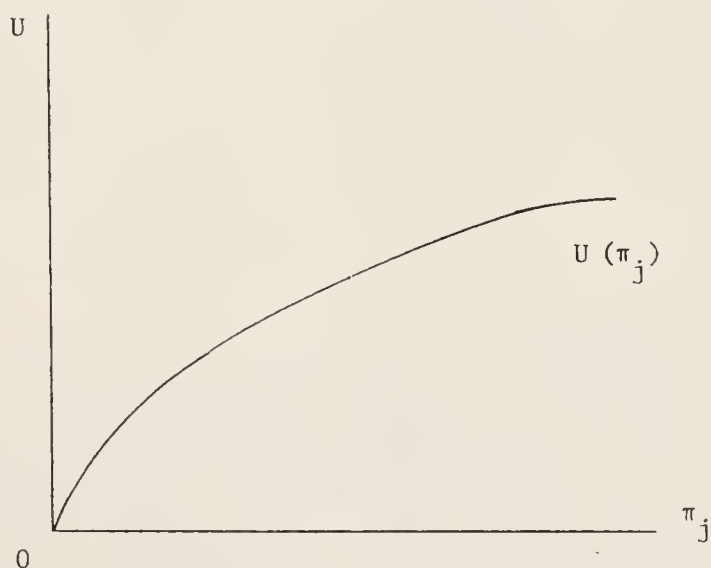


Figure 4.1 Utility of Profits Function for a Risk Averse Lender

Then, under the assumption that lenders are risk averse, the covariance terms in the expression given in (19) will be positive. This is because the marginal utility of profit will, under this assumption, vary inversely with the level of profit which will itself vary inversely with marginal default loss. That is, as marginal default loss rises profits will, *ceteris paribus*, fall and the marginal utility of profits will rise. Therefore, under the assumption that mortgage lenders are risk averse, the final term on the right-hand side of the expression given in (19) above is positive and is added to the other two (positive) terms on that side.<sup>9</sup> These terms may be interpreted as the risk premiums (Pratt, 1964) required by mortgage lenders to originate loans in each of the  $k$  classes. Denoting these risk premiums by  $P_j$ , equation (19) becomes

$$(20) \quad r_j = \frac{dC_j}{dM_j} + E \left[ \frac{\partial L_j}{\partial M_j} \right] + P_j, \quad j = 1, \dots, k$$

Recall that we are interpreting  $E \left[ \frac{\partial L_j}{\partial M_j} \right]$  as the lender's expectation of default loss on the individual mortgage loan being considered for origination and  $\frac{dC_j}{dM_j}$  as the costs of making funds available for this loan. Therefore, equation (20) states that the total interest charge on the individual loan in each quality class must equal the marginal

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<sup>9</sup>Note that the assumption that  $U(\pi_j)$  is concave is crucial to this result. If lenders were risk neutral,  $U(\pi_j)$  would be linear and

$$\text{cov} \left[ \frac{\partial U}{\partial \pi_j}, \frac{\partial L_j}{\partial M_j} \right] = 0,$$

so that the third term in expression (19) would disappear. Also, if lenders were risk lovers,  $U(\pi_j)$  would be convex, and by an argument similar to the one above,

$$\text{cov} \left[ \frac{\partial U}{\partial \pi_j}, \frac{\partial L_j}{\partial M_j} \right] < 0.$$

non-default costs of providing the funds plus the expectation of default loss on the loan plus some positive risk premium that depends upon these default losses and the lender's degree of risk aversion. In the absence of default insurance if the borrower is unwilling to pay this amount, then the loan (with the given terms for class  $j$  loans) will not be originated.

Now, we relax the assumption that default insurance is not available and replace it with the assumption that such insurance is available, where this insurance provides the lender with  $b$  (100) percent coverage against default loss ( $0 \leq b \leq 1$ ). The price per percentage unit of coverage is assumed to be  $\rho$  so that the cost of providing a  $b$  (100) percent level of coverage is  $\rho b$  (100). Since such coverage directly reduces the default risk faced by the lender, provision of a  $b$  (100) percent level of coverage by the borrower will reduce the interest charges on a loan of the  $j^{\text{th}}$  class to

$$(21) \quad r_j^I = \frac{dC_j}{dM_j} + (1 - b) E \left[ \frac{\partial L_j}{\partial M_j} \right] + (1 - b) P_j, \quad j = 1, \dots, k$$

And including the insurance cost of providing this level of coverage, we obtain the total price for insured mortgage funds of the  $j^{\text{th}}$  class as

$$(22) \quad r_j^{I'} = \frac{dC_j}{dM_j} + (1 - b) E \left[ \frac{\partial L_j}{\partial M_j} \right] + (1 - b) P_j + \rho b (100), \quad j = 1, \dots, k$$

The decision faced by the potential borrower of a class  $j$  loan, then, is whether to insure the loan and pay  $r_j^{I'}$  or borrow the funds

without insurance coverage and pay  $r_j$ . Obviously, it will be to the borrower's advantage to provide default coverage on the loan if<sup>10</sup>

$$(23) \quad r_j^{I'} < r_j \quad j = 1, \dots, k$$

Substituting equations (20) and (22) into the inequality in (23) gives us the result that the loan will be insured whenever the following condition is met

$$(24) \quad \rho(100) < E \left[ \frac{\partial L_j}{\partial M_j} \right] + P_j, \quad j = 1, \dots, k$$

Obviously, if all insurance coverage were priced at the actuarially fair rate with no loading factor (i.e.,  $\rho(100) = E \left[ \frac{\partial L_j}{\partial M_j} \right]$ ), then all loans originated with risk averse lenders ( $P_j > 0$ ) would be insured.

As discussed in Chapter II, however, all four sources of default insurance coverage (Section 203, VA, private firms, and FHA subsidy programs) provide a fixed coverage at a fixed price so that actuarial fairness is not attained under any of the available plans. In such a situation,  $\rho$  and  $b$  are given and the probability that condition (24) will be met will depend upon the size of  $E \left[ \frac{\partial L_j}{\partial M_j} \right]$  and  $P_j$ . Since, from the preceding section of this chapter, we know that  $E \left[ \frac{\partial L_j}{\partial M_j} \right]$  is an increasing function of the loan-to-value ratio and term to maturity on the marginal loan being negotiated, then for a given  $P_j$ , it is the level of these terms that will determine whether the loan will be insured or not. Higher loan-to-value ratios and longer terms to maturity increase the probability that for any given insurance plan, condition

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<sup>10</sup> Notice that, under our assumption that mortgage markets are competitive, it makes no difference in the outcome which party pays the insurance premium (borrower or lender).

(24) will be met. Also, it is obvious from this condition that the probability that the loan will be insured will decrease with increases in the price per unit of insurance coverage.

Finally, if we allow  $\rho$  to vary, hold  $E \left[ \frac{\partial L_j}{\partial M_j} \right]$  and  $P_j$  fixed, and sum the individual demands for coverage, we obtain the market demand for default insurance. Given the conclusions reached in the previous paragraph, we may expect this market demand to be a decreasing function of  $\rho$ . Also, if we allow for variations in  $E \left[ \frac{\partial L_j}{\partial M_j} \right]$  through like variations in the loan-to-value ratio and term to maturity, then we may expect these factors to induce shifts in the market demand for default insurance coverage with increases in these terms leading to outward shifts in this demand. We turn now to the supply side of the default insurance market.

### The Supply of Default Insurance Coverage

Default insurance on home mortgages, like most service goods, differs from the standard manufactured good in that the product itself (the insurance contract) is not "produced" until a mutually agreeable price has been settled upon by the purchaser and the supplier of the insurance coverage. Consequently, inventories of insurance contracts cannot exist, and the quantity of insurance produced and consumed must be equal in every period of time. An excess demand in the *ex ante* sense, however, may exist at the quoted premium rate; and, when this occurs, the service can be expected to be rationed on the basis of the perceived degree of underwriting risk exhibited by individual insurance applications (if, of course, the supplier of insurance coverage is profit-motivated). Thus, the underwriting procedure employed in the

provision of insurance coverage may be used as a rationing device, and the extent to which it is being used as such may be inferred from the number of insurance applications that are denied coverage. The amount of rationing that must take place through the underwriting process, however, can be seen to depend upon the pricing structure adopted by the insurance firm in marketing its product.

If this pricing structure consists of multiple premium rates, then the underwriting process may be used to classify individual applicants into the various risk categories for which these premiums are intended. This combination of pricing and underwriting is employed in the provision of many types of insurance (health, auto, life, etc.). With such a multiple rate premium structure, the underwriting process translates applicants' risks into premium rates and only serves as a rationing device for those exhibiting risks that cannot be covered by the highest premium rate class. Such risks are then denied coverage at existing rates and are, thereby, frustrated in their attempt to obtain insurance by non-price rationing of the service.

It is theoretically possible to eliminate rationing through the underwriting process by allowing the number of risk classes enumerated to approach the number of insurance applications. In this situation, the risk that is determined through underwriting is translated into a price for coverage for every applicant. The individual applicant is then free to decide whether the coverage is worth the price and he is not denied coverage outright. With such a pricing structure, the insurance service would be provided at exactly actuarially fair rates (defined above). Such precise pricing, however, would be very unlikely to occur in practice because the costs involved in attempting to predict

expected claims in the underwriting process soon outweighs the benefits of greater enumeration of risk classes. At some number of classes (that is usually considerably lower than the number of applicants) it becomes cheaper to ration the service on non-price grounds than it would be to create more classes and prices. Therefore, information costs generally limit the degree of risk-rating that is feasible in practice.

At the opposite extreme, there may exist only one price and one category (those deemed eligible for insurance) offered by the supplier of insurance coverage. As mentioned in the preceding section and in Chapter II, it is this latter extreme that describes the supply mechanism employed by all four participants in the default insurance market. Under each of the insurance plans available, a single price is quoted and individual applicants are either qualified or disqualified on the basis of certain criteria. Therefore, under none of the plans is the individual loan's expected default loss translated directly into a price for insurance coverage. With only one category of eligible applicants, additional insurance coverage may not be called forth under any of the four plans by ineligible applicants who are willing to pay higher premium rates. Therefore, the quantity of insurance supplied under any of these plans does not rise with the premium rate, and each plan's supply schedule will be infinitely price elastic at the quoted rate.

Such pricing behavior would not be observed in a competitive market composed entirely of profit motivated suppliers of insurance coverage. It is, however, observed in the default insurance market and may be explained in the following manner. First, none of the three

federal government suppliers of coverage in this market attempt to maximize profits. The VA and the FHA subsidy programs have, as their explicit objective, the subsidization of the financing costs of particular groups of mortgagors (veterans and low-income families). The Section 203 program is constrained by its enabling legislation to charge a single price for all coverage provided (Chapter II above), and it is intended only to attain actuarial soundness (which, combined with the single rate premium structure, implies average cost pricing behavior). Then, the private firms in the market, which must be assumed to be profit motivated, are constrained in their pricing and supply behavior by the activities of these federal government programs. Specifically, they must price their service within the interval between the premium rates quoted on these programs (0.5 percent per annum of the outstanding mortgage balance for the Section 203 program and zero for the VA and FHA subsidy programs). Any price equal to or below the lower bound of this interval would, obviously, require that negative profits be earned (i.e., the insurance service would require subsidization). And, any price that is above the upper bound would result in a zero (or near-zero) volume of insurance written since mortgagors would generally be able to obtain the coverage that the lender requires for a loan of given terms at a lower price from the Section 203 program. Within this interval, one might expect that competition among the private firms themselves would, in the long run, force some differentiation of risk classes. As noted above, however, the actual number of classes that may be distinguished is limited by the ability of these firms to separate individual risks on an *ex ante* basis, i.e., by the ability to accurately predict expected default losses on

individual mortgages. Within the relevant price interval, such separation of risks may be extremely difficult. Also, the private mortgage insurance industry is still in the early stages of development, and competitive pressures within the industry have only recently begun to materialize. It should be noted, however, that some initial signs of risk rating within the 0 to 0.5 premium rate interval have emerged within the last few years (Little, 1975). But, given the very recent nature of this development, we may safely ignore price variations within the private mortgage insurance industry in our analysis. In the long run, this single-rate assumption for the private firms in the market may become invalid as the industry grows, as intraindustry competition increases, and as predictive capabilities are improved through accumulated actuarial experience. In this regard, the short run character of the model becomes apparent.

Given the prices at which coverage is provided under the four default insurance plans, the market supply curves for the individual participants will appear as in Figure 4.2.

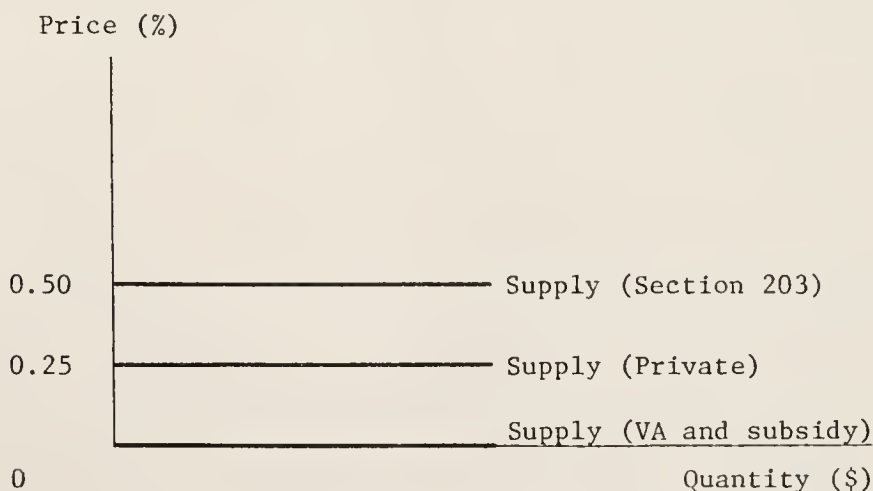


Figure 4.2. Supply Curves of Individual Default Insurance Market Participants

The price of coverage under the different insurance plans is given on the ordinate: one-half percent per annum of the unpaid balance for the Section 203 program; one-quarter percent for the private firms; and zero for the VA and subsidy programs of FHA. The quantity is given on the abscissa: the number of dollars insured against default.

Obviously, if the four types of coverage were homogeneous and the above supply schedules operative, the VA and FHA subsidy programs would usurp the entire default insurance market. The fact that this event has not been forthcoming may be explained by observing that these two programs are operated under rather severe supply constraints. The VA program is constrained by the number of eligible veterans that choose to purchase a house in the given period, and the FHA subsidy programs are constrained by the number of low-income families choosing to purchase a house in the given period and (probably more severely) by the funding level authorized for the programs. Given these supply constraints, the VA and FHA subsidy programs insurance services must be rationed according to the prior military service and the family income of individual applicants. Consequently, a condition of excess demand should exist for these forms of insurance coverage in all periods.

Also, if we are dealing with the market for default insurance coverage for the nation as a whole, we might also expect the supply of private mortgage insurance to be subject to a constraint. This expectation stems from two basic considerations. First, over the period with which we are concerned, there have been constraints of an institutional nature placed upon the quantity of insurance that these firms are allowed to write. These constraints include state prohibitions against the marketing of private mortgage insurance which have been effective

until 1973 when the last state forbidding such insurance (New York) relaxed its prohibition against these firms; and state regulations that limit the growth of the contingent liabilities of these firms by stipulation of a maximum ratio between liabilities and reserves.<sup>11</sup> And second, given the rather narrow interval within which these firms are forced to price their insurance services (discussed above), they will be unable to write coverage profitably on the higher risk loans. They will, therefore, ration their services on the basis of the underwriting risk exhibited by individual loans, and we may expect a situation of excess demand to exist for the coverage that they provide.<sup>12</sup>

Additionally, we must recognize that the services provided under the various insurance plans that are available is not homogeneous. Basic differences in coverage, financing terms, mortgage limits, etc., that were detailed in Chapter II serve to differentiate the four kinds of insurance. It, therefore, becomes necessary to view the default insurance market as consisting of four sub-markets of substitute insurance products, where three of these sub-markets are characterized by conditions of excess demand.

Then, ignoring the subsidy programs and VA for graphical convenience (their treatment would parallel that of the private firms below),

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<sup>11</sup>In the long run, such constraints may be expected to disappear as the private firms in the industry lobby to have state prohibitions relaxed and as contingency reserves accumulate. But, over the period of the 1960's and early 1970's, these supply constraints do appear to have been effective.

<sup>12</sup>Mathematically, one could write the profit function of a mortgage insurance firm as the difference between premium income and expected claims. Then, the problem of the private mortgage insurance firm would be maximize the value of this function subject to both price and quantity inequality constraints.

we can depict the market for default insurance as two inter-related markets as in Figure 4.3. Then, assuming that the supply constraints in the non-Section 203 markets are effective, the demand for Section 203 insurance (which in the absence of supply constraints under this program will determine the quantity of Section 203 insurance written) will be influenced by the quantity of default insurance written by the alternative suppliers of default coverage. In Figure 4.3, the excess demand existing in the private market ( $Q_D^P - Q_S^P$ ) with the given supply constraint will, to some extent, be channelled into the market for Section 203 coverage, thereby raising the level of demand in that market. If the two forms of insurance were perfect substitutes (i.e., if the coverage provided were homogeneous) then the demand for Section 203 insurance would be given by the horizontal distance AB in the graph.

They are not, however, perfect substitutes for reasons mentioned above; and, as a result, we are unable to deduce the quantitative relationship between the excess demand for private insurance and the level of demand for Section 203. But, as is obvious from Figure 4.3, an increased supply of the rationed (constrained) insurance will result in a decrease in the excess demand in that market (holding the level of demand constant) and, *mutatis mutandis*, a decrease in the demand for Section 203 coverage. Thus, a partial relaxation of the supply constraint to  $Q_S^{P'}$  reduces excess demand in the private market to  $Q_D^P - Q_S^{P'}$  and the demand for Section 203 insurance at the existing price falls to  $Q_{S,D}^{203'}$ .

Indeed, it has been shown that the effect of a change in the rationed quantity of any good on the demand for an unrationed related good will be proportional to the substitution effect of a change in the

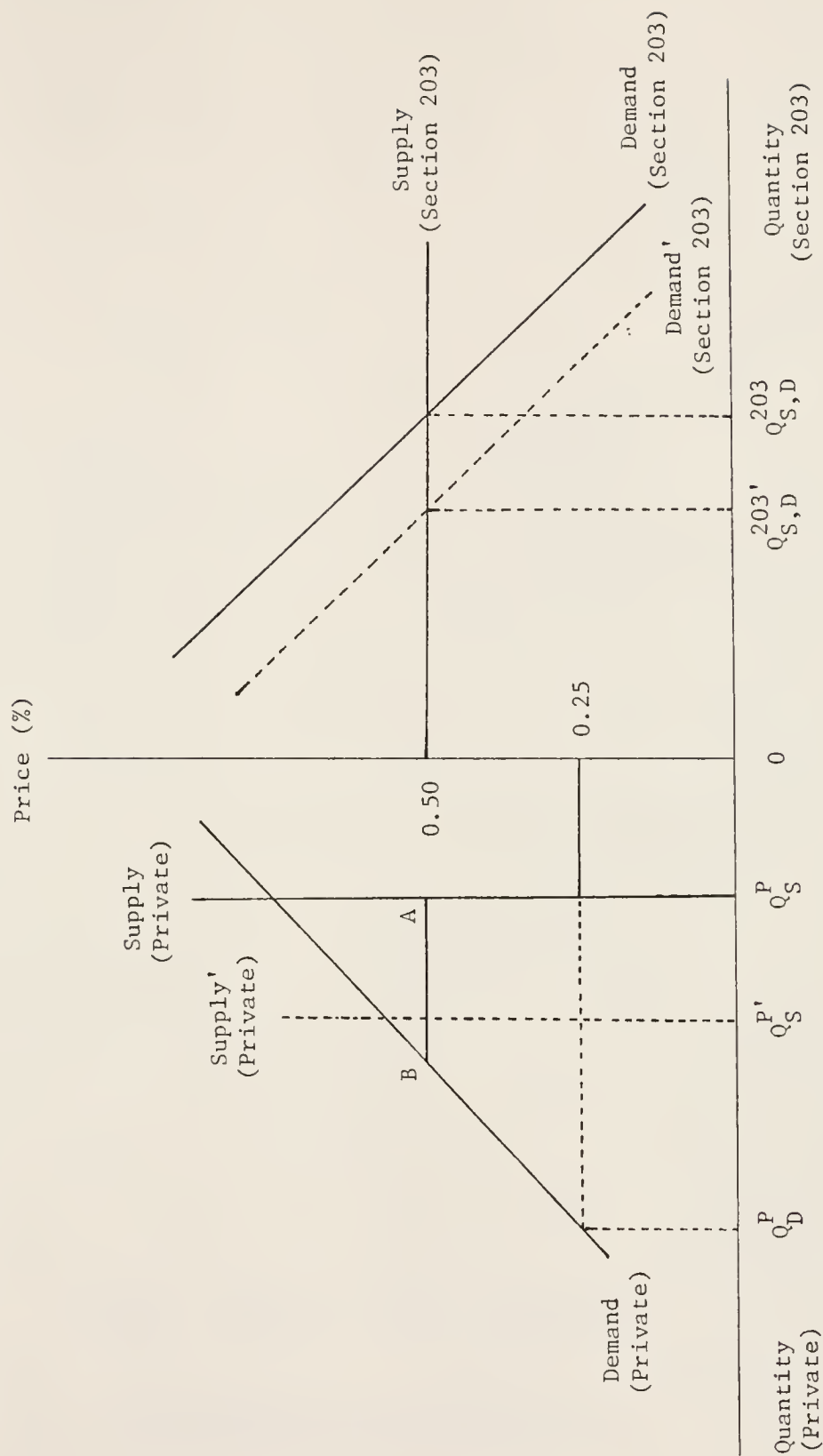


Figure 4.3. The Relationship Between Private Market Supply Constraints and Section 203 Demand in the Default Insurance Market

price of the unrationed good on the demand for the rationed good in a free market (Tobin and Houthakker, 1951; Houthakker, 1961, pp. 714-715). This means that if the two goods are substitutes, then an increase in the quantity of the rationed good will reduce the demand for the unrationed good, as is pictured in Figure 4.3.

Obviously, since the price of insurance coverage under each of the four sources of supply has remained constant throughout time in both absolute and relative terms, it will be impossible to directly measure the own price elasticity of demand or the cross price elasticities of demand for the different types of coverage. Any empirical analysis of the default insurance market will, of course, implicitly contain the effect of own prices, but such effect will, due to the complete lack of variation, be imbedded in the constant term of the regression equations. Also, because of the effect stated above, the cross price elasticities of demand will be imbedded in the coefficients of the rationed quantities. It is of interest to note, however, the effect that changes in the number of related rationed goods will exert on the own-price substitution effect of the unrationed good. Samuelson (1947) has shown that the own-price substitution effect for the unrationed good will be larger in absolute value as the number of rationed goods is reduced. This result is referred to as the principle of Le Chatelier because of its analagous relationship with the theorem employed in thermodynamics (Samuelson, 1947, p. 38, footnote 13). As Samuelson points out, this principle provides an exact basis for the classic distinction elaborated by Marshall between the long run and the short run (Houthakker, 1961, p. 715; Samuelson, 1947, pp. 36-46). Since excess demand must equal zero in the long run, no rationing occurs and own-price substitution

effects will be larger. Thus, at a given level of consumption, price elasticities of demand will be larger in absolute value in the long run than they are in the short run. With regard to the Section 203 program, this result implies that as rationing in the default insurance market is eliminated over time (through, for example, relaxation of legal constraints on the private firms in the market) the demand for insurance coverage under this program can be expected to become more price sensitive.

We now summarize the important findings contained in this chapter and relate them to the decline in insurance activity under the Section 203 program.

#### Summary: Basic Theory of Decline

The model that has been developed in the preceding sections contains several theoretical implications that provide a basic framework for analyzing the operation of the default insurance market over the post-war period and particularly for examining the causal forces behind the decline in insurance activity under FHA's Section 203 program. This framework will be adopted in the following chapters as the basis for an empirical model designed to yield inferences about the causes of this decline. The model will, of course, serve to both test the theoretical framework and provide empirical evidence of the quantitative impact of the various factors implied by the theory.

The first major implication emanating from the above theory is that total default insurance market activity is primarily determined by the level of demand for such insurance. This result stems from the single price supply mechanism employed by all participants in the market which

leads to individual program supply curves that are infinitely price elastic up to the point at which supply constraints become effective. Some influence on total insurance market volume may, of course be exerted by fluctuations in the level of these constraints; but to the extent that Section 203 coverage serves as a substitute for the coverage provided by other (supply constrained) participants in the market, such fluctuations will only affect the distribution of insurance market activity among these participants and will not affect the total volume of insurance written. To the extent, however, that Section 203 does not serve as a workable substitute for the other forms of coverage offered in the market, variations in the level of the supply constraints imposed on these other participants will influence the observed quantity of total insurance written. But, since these constraints are not altered in response to market conditions but, instead, fluctuate with legal and other institutional changes (such as the number of veterans leaving the armed services), they may be considered as exogenous. Therefore, the estimation of an empirical behavioral relationship with total insurance volume as the dependent variable will not encounter the usual simultaneous equation problems confronted in most market analyses, and such a relationship may be interpreted as a demand equation with (as mentioned above) the price term implicit in the constant.

Also, the above theory implies that total default insurance market demand will be an increasing function of the overall level of activity in the mortgage market since the demand for default coverage is derived from the demand for and supply of mortgage funds under conditions of default uncertainty. Obviously, if more mortgages are originated, then, *ceteris paribus*, more insurance will be demanded at the existing

premium rate since market demand is given by a simple summation across individuals who find it optimal to insure their loans (where the essentially binary decision to insure is governed by whether or not condition (24) is met for each loan). Also, the level of the financing terms that are available on insured mortgages will exert an influence on this total demand. For a given volume of mortgage originations, a larger proportion will be insured (i.e., condition (24) will be met for more of the given total) the higher is the loan-to-value ratio and term to maturity on the loans deemed eligible for insurance. Consequently, total market demand will be an increasing function of overall mortgage market activity and the level of financing terms available on insured loans.

More important for our basic purposes in this study, however, are the implications of the theoretical model for the Section 203 insurance program. First, the theory implies that the volume of insurance written under this program is completely demand-dependent. Any observed variations in activity under the program must be generated through shifts in the demand schedule for Section 203 coverage. Therefore, we must look to factors that create such demand shifts in order to explain the movements in Section 203 insurance volume over time (i.e., to explain the decline). Since such an explanation is the primary purpose of this study, most of the remaining efforts will be directed at investigating these factors.

The theory developed above contains several important implications concerning the factors that are likely to have led to these demand shifts. Three basic sets of factors are implied. Given some degree of substitutability between Section 203 insurance coverage and the coverage provided by alternative suppliers, the demand for the former will

be an increasing function of the excess demand for the latter. This, in turn, implies two sets of factors that can be expected to influence the level of demand for Section 203 coverage. First, the overall level of housing and mortgage market activity will directly influence the level of demand under this program since increases in the total demand for default insurance will be fed (either directly or indirectly) into this demand schedule. Increases in total demand will raise the demand for all forms of coverage; and, with supply constraints on the VA, private, and subsidy programs, the Section 203 demand will, *a fortiori*, increase. And second, inverse demand shifts for Section 203 coverage may be expected to occur with fluctuations in the level of the supply constraints imposed on these alternative programs. As these constraints are relaxed, the volume of insurance written by these suppliers of default coverage will increase, the excess demand existing in their related markets will be reduced, and the demand for Section 203 will decline. And third, the demand for Section 203 coverage will depend upon the level of financing terms available on mortgages insured under this program relative to the terms available on insured loans elsewhere in the market. Since the coverage provided and price charged for Section 203 insurance are above those of alternative suppliers of default coverage, the risks insured should be expected to be higher under this program. Assume an individual loan exists that is not eligible for insurance under the VA or subsidy programs. Assume further that condition (24) is met for both Section 203 and private coverage. Then, since the net savings on the loan that is obtained by providing default coverage is equal to the amount by which the right-hand side of (24) exceeds the left-hand side, the individual will select the type of

coverage that is desired on the basis of a comparison between the level of risk that is acceptable to the two insurers in relation to the prices charged for coverage. Given these prices, he will select the type of coverage that yields the largest difference between price and risk (where risk is defined here as the sum of expected default loss and risk premium on the loan). And, the likelihood that this difference will be greater for Section 203 coverage is increased as the risks acceptable for insurance under this program are increased relative to the risks under the alternative source of coverage. Therefore, the more liberal Section 203 terms become (i.e., the higher the loan-to-value ratio and term to maturity) relative to the rest of the market, the greater will be the demand for insurance coverage under this program.

Adopting this theoretical framework, we are now in a position to begin specification of an empirical model of the default insurance market that may provide useful insights concerning the post-war operation of this market and the decline of FHA's basic single-family unsubsidized program. Given the nature of this market (with three of the four participants' insurance volumes being determined primarily by variations in the level of their respective supply constraints), the availability and quality of the relevant data (alluded to in Chapter II), and the current level of federal interest in FHA, particular attention will be devoted to that portion of the model that relates to Section 203 insurance volume.

## CHAPTER V

### THE EMPIRICAL MODEL: SPECIFICATION

#### Introduction and Overview of the Empirical Model

The empirical model that is developed in the remaining chapters of this study utilizes the theoretical framework of the preceding chapter to specify a set of structural equations that, together, determine the total default insurance market activity and allocate this total to the various participants in that market. The model contains six behavioral equations and one identity. Because of the nature of the theoretical model, however, these equations are, for the most part, non-simultaneous. This results from the assumption that the supply constraints determining non-Section 203 insurance volumes are effective over the entire sample period. This assumption constitutes a fundamental maintained hypothesis throughout the analysis; and as a result, simultaneity between the insurance volumes of the various participants in the market is not incorporated in the model.

Separate equations are specified for the following dependent variables: total market volume; VA volume; private volume; Section 203 volume on new units; Section 203 volume on existing units; and Section 203 processing time. This final equation is specified to explicitly account for simultaneity between Section 203 volume and processing time and also to investigate certain hypotheses concerning the factors that determine this processing time. The first three of these equations

contain no right-hand endogenous variables while the last three do contain such variables. The addition of a simple identity to account for the volume of insurance activity under the FHA subsidy programs, then, serves to complete the model's description of the default insurance market for single-family mortgages. Consequently, this entire market and all four sub-markets are accounted for by the model and, as a result, individual program market shares are implicitly explained.

The basic results that may be expected to flow from this model fall logically into two broad categories. First, conclusions should emanate concerning the overall functioning of the default insurance market, including those factors that operate to determine the total activity in this market and those factors that allocate this total among the various sub-markets that are present. And second, a definitive explanation of the Section 203 decline should be forthcoming from this model, thereby facilitating (but by no means assuring) rational policy reactions on the part of federal decision-makers concerned with this program. We now specify the equations that constitute the empirical model and relate them to the theoretical model that has been developed.

#### Equation 1: Total Market Volume

The first equation in the model determines total default insurance market activity (i.e., the sum of the insurance volumes written by VA, private firms, Section 203, and FHA subsidy programs). This equation provides the principal connecting link from the housing market and mortgage market sectors to the default insurance market sector that is described by the model. Also, the view that the demand for default

coverage is, in general, derived (recursively) from the demand for mortgage funds is made explicit in this equation, and we are able to allow activities in the housing and mortgage markets to exert a direct influence on the default insurance market.

From the theory developed in Chapter IV, the total market volume is determined by the level of demand for default insurance (which, itself, depends upon the number of mortgages originated and the financing terms applied to these originations) and the level of the supply constraints imposed on the non-Section 203 participants in the market. Therefore, we first specify the total volume of mortgage insurance written as an increasing function of mortgage originations. Since the insurance contract cannot be written unless the loan to be insured is originated, we specify the relationship between originations and insurance with no constant term. Thus, the hypothesis is that some portion of originations are insured in the given period, i.e., that

$$(1a) \quad \text{TOT} = F_{1.1} (\text{ORIG})$$

where we expect the coefficient  $F_{1.1}$  to be greater than zero and where the variables in this equation are defined as:

TOT = the total number of single-family units insured.  
it is defined in our model as the sum of the single-family insurance volumes of FHA (Section 203 plus subsidy program volumes), VA, and the private firms in the market; and

ORIG = total single-family mortgage originations, both insured and uninsured, in millions of 1971 dollars. It is assumed that these are given exogenously to the mortgage default insurance market by the outcome of a simultaneous process operating in the housing and mortgage markets.

Now, from the theoretical model, we hypothesize that the proportion of total mortgage originations that are insured,  $F_{1.1}$ , is an

increasing stochastic function of the loan-to-value ratio and term to maturity on all insured mortgages, and the exogenous factors that determine the level of the supply constraints imposed on the VA, subsidy programs, and private insurance volumes. For the loan-to-value ratio and term to maturity series, we would ideally employ weighted averages of the terms offered on all insured mortgages; but, since no data exist on the terms offered on privately insured loans, we adopt the simple averages for those insured under Section 203. Since, in general, the terms offered under the VA and FHA subsidy programs are more liberal (i.e., higher loan-to-value ratios and term to maturities) and the terms offered on privately insured mortgages are less liberal than those under the Section 203 program, these series should approximate the terms available on all insured loans fairly well. The exogenous variable used to determine the level of the supply constraint for VA guaranteed loans is the number of veterans eligible for such loans. For the subsidy program supply constraint, we adopt a simple binary variable that is equal to one over the 1968-1971 period during which the greatest funding for these programs was authorized. And finally, in order to determine the level of the supply constraint imposed on the private firms in the market, an index that measures the degree of availability of private mortgage insurance in the national market was constructed. It is defined as

$$PMIA = \sum_{i=1}^{50} d_i w_i$$

where

$$d_i = \begin{cases} 0 & \text{before private insurance became available in} \\ & \text{state } i \\ 1 & \text{after private insurance became available in} \\ & \text{state } i \end{cases}$$

and

$w_i$  = a weighting factor equal to the number of single-family housing units in state  $i$  divided by the total number of single-family housing units in the U.S. in 1970.

Thus, this availability index varies from zero (before 1957 when private mortgage insurance was completely unavailable) to one (after the third quarter of 1973 when private mortgage insurance became available in all states).<sup>1</sup>

Thus, we specify the following relationship:

$$(1b) \quad F_{1.1} = b_{1.0} + b_{1.1} (LFHA) + b_{1.2} (TFHA) + b_{1.3} (VET) \\ + b_{1.4} (SD) + b_{1.5} (PMIA) + e_1$$

where the variables in the equation are defined as:

LFHA = average loan-to-value ratio on Section 203 insured loans;

TFHA = average term to maturity on Section 203 insured loans;

VET = number of veterans eligible for VA loan guarantees;

SD = a dummy variable that is equal to one over the 1968-1971 period and is equal to zero otherwise;

PMIA = private mortgage insurance availability index (defined above); and

$e_1$  = a random variable.

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<sup>1</sup>This index was suggested by Fred Eggers of the U.S. Department of Housing and Urban Development.

Substituting (1b) into (1a) and dividing by ORIG yields our estimating equation as:

$$(1c) \text{ TOT/ORIG} = b_{1.0} + b_{1.1} (\text{LFHA}) + b_{1.2} (\text{TFHA}) + b_{1.3} (\text{VET}) \\ + b_{1.4} (\text{SD}) + b_{1.5} (\text{PMIA}) + e_1$$

which may be fit using single equation estimation techniques.

The hypotheses that are implied by the theoretical model are that  $b_{1.0}$ , ...,  $b_{1.5}$  will all be positive. The logical basis from which these hypotheses stem is that increases in mortgage originations will generally result in increases in the demand for mortgage insurance which, in turn, results in increases in the volume of insurance written ( $b_{1.0} > 0$ ). The proportion of the additional originations that are insured,  $F_{1.1}$ , increases with more liberal terms on insured loans ( $b_{1.1} > 0$  and  $b_{1.2} > 0$ ) and with increases in the level of supply constraints imposed on non-Section 203 participants in the default insurance market ( $b_{1.3} > 0$ ,  $b_{1.4} > 0$ , and  $b_{1.5} > 0$ ). Finally,  $F_{1.1}$  is a random coefficient that varies over the sample and, as a result, was not tested statistically. It should, however, remain positive over all observations (i.e., an increase in originations should never decrease the demand for insurance).

#### Equation 2: VA Insurance Volume

The number of mortgage guarantees issued by the Veterans Administration in any given period does not adjust to the market demand for the service provided at the price charged (as noted above, this price is essentially zero). Instead, the supply of these guarantees is constrained by the number of veterans that are eligible by law for

such guarantees. Therefore, the number of eligible veterans constitutes the supply constraint that is effective in the VA sub-market, and the volume of guarantee activity in this sub-market will be determined solely by movements in this constraint. Thus, we specify the following equation for VA volume:

$$(2) \quad VA = b_{2.0} + b_{2.1} (VET) + e_2$$

where

VA = the number of single-family mortgage guarantees issued by the Veterans Administration in the given period, and

$e_2$  = a random variable.

VET was previously defined, and  $b_{2.0}$  and  $b_{2.1}$  are the parameters to be estimated.

The only hypothesis regarding this equation is that  $b_{2.1}$  will be greater than zero, i.e., that increases in the number of veterans eligible for VA guarantees will result in increases in the number of guarantees issued. Since VET is determined by influences that are exogenous to the model, the variations in this supply constraint are exogenous and a single equation (non-simultaneous) estimation technique is appropriate.

### Equation 3: Private Mortgage Insurance Volume

Like the VA sub-market, the private default insurance sub-market is assumed to be characterized by a condition of excess demand at the price quoted. Supply constraints have forbidden these firms from meeting the entire demand at this price and, as a result, variations in the observed quantity of insurance written by the private firms has been

completely dependent upon their capacity to increase insurance volume in the national market. As mentioned in Chapter II, such capacity has been constrained over our sample period by two major factors. First, legal prohibitions in the various states have constrained the capacity of these firms to expand output. Until 1957, this constraint was constant at a zero level of output because private mortgage insurance was forbidden in all states. Since that time, these prohibitions have been gradually relaxed with the last state (New York) allowing these firms to enter in 1973. And second, the capacity of the private mortgage insurance industry to expand output has been constrained by their ability to accumulate the contingency reserves required to write additional policies (the requirement in most states is a 25 to 1 ratio between insurance liability and reserves). Together, these two factors have operated to determine the private firms' capacity to write new policies and meet the excess demand for the coverage that they provide.

In attempting to specify a behavioral equation to determine the insurance volume written by the private firms in this sub-market, then, we have only to determine the movements of the supply constraint faced by these firms over time. To do this, we employ the private mortgage insurance availability index, PMIA, described above. We do not, however, have data on the contingency reserves of the private firms in the market. Since these reserves are generally accumulated over time as the firm or firms carry out business in a given state, we hypothesize that the response of private mortgage insurance volume to an increase in the availability index is characterized by a distributed lag structure. Specifically, we postulate that the effect of legal availability on insurance volume will build up over a number of quarters as private firms

complete the necessary applications to carry out business, set up insuring offices within the state, and begin to accumulate contingency reserves. Then, the effect of an increase in the availability index should decline beyond a certain number of quarters as a sufficient number of firms enter and a sufficient volume of insurance becomes feasible to reduce the excess demand in the particular state. In no quarter, however, should an increase in availability lead to a decline in private insurance volume, so the coefficients of the distributed lag structure should remain positive.

These considerations led to the adoption of a second degree polynomial distributed lag structure of the Almon variety. Some experimentation with the length of time over which the lagged effect takes place led to the use of a twelve quarter response period. No constraints were imposed on the first or last period coefficients. Therefore, the specification adopted for the private mortgage insurance equation is given by:

$$(3) \quad \text{PMI} = b_{3.0} + b_{3.1} (\text{PMIA}) + b_{3.2} (\text{PMIA1}) + \dots \\ + b_{3.12} (\text{PMIA11}) + e_3$$

where we require that

$$(3a) \quad b_{3.i} = \alpha + \beta (i) + \delta (i)^2 \quad \text{for } i = 1, \dots, 12$$

and where

PMI = the number of single-family units insured by the private mortgage insurance industry in the given period;

PMIA<sub>i</sub> = the private mortgage insurance availability index (defined previously) lagged *i* periods; and

$e_3$  = a random variable.

The parameters  $b_{3.0}, \dots, b_{3.12}$  are the coefficients to be estimated with  $b_{3.1}, \dots, b_{3.12}$  given from estimation of  $\alpha, \beta$ , and  $\delta$  from (3a) above.

The hypotheses that stem from the discussion above are that  $b_{3.1}, \dots, b_{3.12}$  will all be positive and that  $b_{3.1}$  and  $b_{3.12}$  will be smaller in size than the coefficients that lie between them in the lag structure, i.e., that

$$0 < b_{3.1} < b_{3.j} > b_{3.12} > 0 \quad \text{for } j = 2, \dots, 11$$

Finally, since the private mortgage insurance supply constraint is exogenous to the model, no simultaneity problems arise in this equation.

Equation 4: Section 203  
Insurance Volume on New Units

The empirical model employed in this study specifies separate equations for Section 203 insurance volumes on new and existing units. This separation of insurance volume by property type was specified for two reasons. First, the observed decline in insurance activity has been somewhat different for the two categories of property securing the mortgage, with the decline beginning earlier and progressing more continuously for insurance written on new units (see Chapter II). And second, the marginal impact of variations in the explanatory variables employed may differ depending upon the type of unit insured (perhaps because of differences in sellers--builders versus owner occupants). Therefore, the coefficients in these two equations may differ substantially, and separate estimation may be appropriate. As will become evident later in the study, such separation does appear to have been warranted.

As noted above, the theoretical model of the preceding chapter implies that Section 203 insurance volume is demand-dependent. Thus, the Section 203 equations constitute demand equations where, due to the complete lack of variation in premium rates, the price terms are implicit in the constant intercepts of the relationships specified. Other factors that may be expected to affect the level of demand for Section 203 coverage that are implied by the theoretical model can be logically grouped into three categories: the level of supply constraints imposed on alternative suppliers of default insurance; the relative terms available on Section 203 insured mortgages; and other product differentiating factors that may serve to shift the demand for coverage under the Section 203 program. This section explores each of these categories in some detail in order to arrive at the specification that will be used in the estimation.

#### Supply Constraints on Alternative Sources of Default Coverage

The theory of Chapter IV implied that the demand for Section 203 insurance coverage would be inversely related to the actual level of the supply constraints imposed on the VA, subsidy program, and private insurance volumes because of the substitutability between the services provided under these programs and that provided by Section 203. Given our maintained hypothesis that the supply of insurance by these alternative sources is constrained by exogenous (non-price) factors and that these supply constraints have remained effective throughout the sample period, the level of these constraints will be equal to the actual volume of insurance written by these non-Section 203 participants in their various sub-markets. Therefore, volumes observed under these

alternative insurance programs should bear an inverse relationship with Section 203 demand, and each of these volumes should be included in the Section 203 demand equations.

In addition to the simple substitutability issue between alternative suppliers of default coverage, a particularly important question arises regarding the insurance volume of the private firms in the market. As was pointed out previously, the supply mechanism employed by Section 203 consists of the classification of mortgage insurance applicants into a single eligible category to which a single price of insurance coverage is quoted. There are fundamental, long-term problems created by such a supply mechanism that will, over time, lead to a decrease in the volume of business and an increase in the average claims rate experienced on remaining business insured under Section 203. These effects arise from the incentives created by this supply mechanism and the operation of an increasingly competitive private market.<sup>2</sup> They can be forestalled for a period of time by product differentiation on the part of Section 203, but (in the absence of legal prohibitions on entry into the industry) they cannot be avoided indefinitely. The related phenomena of cream-skimming and adverse selection give rise to these effects and could possibly account for a large part of the problems presently being experienced by FHA in the single-family unsubsidized market. The mechanism whereby Section 203's price structure gives rise to these phenomena is the subject of this sub-section.

Since the payment of insurance claims on foreclosed properties is one of the primary costs of carrying out a default insurance program,

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<sup>2</sup>This statement and the remainder of this sub-section draw heavily from Mark Pauly (1970).

the probability of default and expected default loss on properties insured must affect the expected costs of providing insurance coverage. Furthermore, since the probability of default and expected default loss differ on individual mortgage contracts (varying with the financing terms of the loan) the expected costs of providing a given level of coverage must vary from one contract to another. Therefore, if the insurance program is to be actuarially sound (as the FHA unsubsidized program was intended to be) and a single price is to be charged on all insurance written, then the price charged must be equal to the average cost of providing coverage on all contracts written. This, in turn, means that, *ceteris paribus*, mortgagors purchasing Section 203 insurance will be charged a premium rate that is higher (lower) than the expected costs of providing the insurance service to them as the probability of their defaulting and expected default loss is lower (higher) than the average for all Section 203 insured loans. In other words, the better (or preferred) risks within the FHA unsubsidized program must pay insurance premiums that exceed the marginal costs of providing coverage to them; and, conversely, the worse risks within this program pay premiums that are less than marginal costs. In effect, the higher-than-cost premiums of the preferred risks serve to offset the lower-than cost premiums of the worse risks; therefore, an internal

cross-subsidization of insurance premiums takes place within the Section 203 program.<sup>3,4</sup>

This means of pricing the insurance service constitutes a form of price discrimination.<sup>5</sup> The relative price of the insurance service is distorted from that which would exist under pure competition and, as a result, the distribution of the service among consumers will be similarly distorted. A smaller than optimal volume of coverage will be purchased by the better risks and a larger than optimal volume of coverage will be purchased by the worse risks than that which would be desirable from a welfare economics point of view (Pauly, 1970).

From the point of view of Section 203, such price discrimination will, in the long run, lead to a loss of business and an increasing average default rate on remaining business. Since many of FHA's

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<sup>3</sup> Notice that the direction of the subsidization that occurs needs bear no particular relation to mortgagor income since a monotonic relationship between income and default probability does not appear to exist although the trend will be in favor of a progressive redistribution (Aaron, 1972; von Furstenberg, 1970). Also, the size of the subsidy is not subject to direct control by those designing or implementing the program, but rather, it depends upon the actual risks on the insured loans. For these reasons, internal cross-subsidization within an insurance program represents a highly inefficient means to carry out the subsidy function (Pauly, 1970).

<sup>4</sup> It should also be noted that the payment method employed by FHA in collecting insurance premiums compounds this subsidization process. By collecting premiums in monthly installments, defaulting mortgagors are allowed to "default" on insurance premiums also. Therefore, those mortgagors who do not default (who, by definition, are generally those with a lower probability of default) must pay part of the premiums of those mortgagors who do default in order for the insurance fund to be actuarially sound. Payment of insurance premiums prior to the coverage period is necessary to correct this form of cross-subsidization.

<sup>5</sup> Price discrimination is defined as either the charging of different prices to different consumers for goods that cost the same amount to produce or the charging of the same price to different consumers for goods that cost different amounts to produce. The latter definition describes the pricing policy of Section 203.

customers are forced to pay insurance premiums that exceed the costs of providing the service to them, new firms will be attracted into the mortgage insurance industry (as has been happening since the Mortgage Grarantee Insurance Corporation entered in 1957) because it is profitable for them to offer these preferred risks a lower premium rate per unit of insurance coverage. It is, obviously, preferable from the point of view of these better risks to opt for this private insurance unless the Section 203 coverage is differentiated sufficiently to render private coverage an unacceptable substitute since the total cost of securing the mortgage (interest charges plus insurance premium) is lower with such insurance. The private coverage may not, itself, be priced at the actuarially fair rates; but, for the preferred risk customers, the lower level of premiums offered represents a closer approximation to such rates than that available under Section 203. Over time, the competitive process should force rates in the private market toward the actuarially fair levels.<sup>6</sup>

This process of bidding away the preferred risk customers is known as cream-skimming<sup>7</sup> and should be expected to occur and continue as long as two conditions co-exist: (1) some purchasers of default insurance are paying more than the actuarially fair price for the insurance coverage; and (2) there is some operational mechanism by which these preferred risks may be distinguished. In the mortgage insurance industry,

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<sup>6</sup> Some very recent evidence of such an occurrence is found in Little (1975). The private firms in the industry have begun to distinguish multiple risk categories to which the price of coverage varies with risk.

<sup>7</sup> Purely on grounds of economic efficiency, the process of cream-skimming is desirable since the very existence of the "cream" is an indication that a non-optimal pricing policy is being followed (Alfred E. Kahn, 1971).

this process should not be expected to occur overnight; but rather, it should proceed over time in an iterative fashion with the very best (and most easily distinguished) risks being bid away first (perhaps contracts on new units) and increasingly worse risks being bid away later (perhaps contracts on existing units) as actuarial experience is accumulated.

Also, the process of cream-skimming is limited by the capacity of the private mortgage insurance industry to increase the volume of insurance written, i.e., by the level of the supply constraints faced by the private firms in the industry. As legal prohibitions have been dropped and as reserves have grown, the volume of insurance written by these firms has increased and the cream-skimming process has accelerated apace. Thus, Section 203 should be expected to lose customers over time as the private mortgage insurance industry grows and as competition from and within this industry allows the better risks to obtain their coverage at a lower price in the private market; and, the coefficient for private firms' volume in the Section 203 demand equation may be interpreted in terms of this process.

With regard to the effect of this process on the average default rate (and thereby, the actuarial soundness of the single price being charged) of Section 203 insurance loans, the outcome is obvious. The private mortgage insurance industry will be unwilling to insure the higher risk categories unless the actuarially fair price (or above) can be charged for the provision of such insurance. But, since these customers are presently receiving their insurance at subsidized rates (with the subsidy coming from the lower risk customers), it will be impossible to bid them away by offering insurance at actuarially

fair rates. Therefore, the poor risk customers will remain within the Section 203 insurance program and the average quality of the mortgages within this program will decline as cream-skimming progresses. This is the adverse selection that necessarily results from the process; and, eventually, it should necessitate an upward revision of the price charged for Section 203 insurance if the single-price supply mechanism is retained and insurance reserves are to remain positive.<sup>8</sup> Consequently, declining volume with rising claims rates can be seen to be a direct result of FHA's failure to offer actuarially fair insurance rates to individual customers.

This result, that appears to be inevitable in the long run, can be temporarily forestalled by product differentiation efforts on the part of Section 203. As we pointed out previously, the demand for Section 203 default insurance is affected by the relative terms available on the loans insured under this program. These and other characteristics serve to distinguish this insurance from private insurance and, hence, can be manipulated in such a way as to counteract the effects of cream-skimming on the part of the private firms by reducing substitutability between the services provided. Such manipulations, however, can be expected to be followed by similar adjustments in the characteristics of loans insured in the private sector as firms in this sector seek to

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<sup>8</sup> Notice, however, that this new, higher premium rate will still represent an average of the costs of providing coverage to remaining Section 203 customers. Therefore, those who had previously paid premiums that were marginally below the actuarially fair rate may now be forced to pay premiums that are above this rate; and consequently, it now becomes profitable for the private firms to bid these customers away. Ultimately, if Section 203 were to maintain its single price supply mechanism and charge a premium rate sufficient to maintain actuarial soundness, its business would be reduced to the very worst risk customers at the margin between insurable and uninsurable risk.

attract the preferred risks from Section 203. Therefore, these adjustments cannot be effective in the long run. As long as the single price supply mechanism is adhered to and as long as the price charged is sufficient to cover the costs incurred (i.e., no overall subsidization of total insurance premiums occurs) such measures will have only temporary effects--Section 203 will continue to lose business and experience increasing claims.

This hypothesis that cream-skimming has taken place in the default insurance market and that such cream-skimming has been an important contributing factor in the decline of the Section 203 program cannot be tested directly without detailed data on the risk-related characteristics of privately and Section 203 insured loans. Such data is unavailable at this time, so a direct test of this hypothesis cannot be carried out. Two indirect tests, however, will be conducted that will help to verify the legitimacy of this theoretical result. First, the inclusion of private insurance volume in the Section 203 demand equations should give an indication of the substitutability of this type of coverage for that offered by the FHA program. A negative sign will, of course, indicate that substitution has occurred and, as a result, indirectly confirm the cream-skimming hypothesis. And second, an additional test of this hypothesis will be carried out by including private mortgage insurance volume as an explanatory variable in a regression equation with the Section 203 default rate as the dependent variable. Here, a positive sign will provide additional confirmation (though still indirect) of the cream-skimming hypothesis.

### Relative Terms Available on Section 203 Insured Loans

From the theory presented in Chapter IV above, we may expect the contract terms on Section 203 insured mortgages (these terms being the loan-to-value ratio, term to maturity, and rate of interest) relative to the terms on non-Section 203 insured loans to have an influence on the volume of insurance written under Section 203. The rationale for this expectation is that these terms influence the default risk on the loan and, for a given price of insurance coverage, it is this risk that determines the value of the insurance to the borrower (i.e., the size of the interest savings *minus* insurance premium to be gained by insuring the loan). The greater the risk an insurer is prepared to accept for a given price, the greater is the savings to the borrower from purchasing the insurance. Therefore, we may expect an alteration of any of the contract terms on Section 203 insured loans relative to other loans available in the market to influence the volume of Section 203 activity as such alterations affect the relative attractiveness of these loans from the borrower's point of view. Specifically, as the term to maturity and loan to value ratio on Section 203 insured loans are increased relative to the term to maturity and loan-to-value ratio on non-Section 203 loans, the demand for Section 203 insurance should increase. Therefore, the empirical model will incorporate the difference between the average Section 203 and conventional terms to maturity and loan-to-value ratios for mortgages originated in the given quarter in the two Section 203 demand equations. By the theory of Chapter IV, the *a priori* expectation regarding the signs of the coefficients of these variables is that they will be positive.

With regard to the interest rate differential between conventional and Section 203 insured loans, competition in the mortgage market (to the extent that workable competition exists) should maintain a difference approximately equal to the market's valuation of the differences in risk on the two types of loan. This difference, then, can be thought of as an interest rate risk premium (Pratt, 1964), and its size and sign will depend upon this relative risk--which, in turn, will depend upon the risk-related contract terms. If these terms were identical on conventional and Section 203 insured loans, then the risk premium should remain positive and fairly constant over time if both rates are determined competitively (i.e., the Section 203 rate should be below the conventional rate). This is because, *ceteris paribus*, the lender's risk exposure is always greater on conventional loans since they are either uninsured or coinsured as opposed to the 100 percent coverage offered under Section 203. The interest rate charged on FHA-insured loans is, however, constrained by the regulated interest rate ceiling; and, at times, the differential between the conventional and the FHA interest rates may come to exceed the equilibrium risk-related differential. The market's reaction to this situation is the payment of points by the borrower to the lender of FHA-insured loans (Hood and Kushner, 1971) to compensate for the unwarranted (by risk differences) differential. Such points represent the payment to the lender for foregone interest earnings created by originating Section 203 insured loan. If the point system works perfectly, the effective interest rate differential would be brought back into equilibrium and the departure of the regulated rate from the market difference would not influence the volume of FHA activity at all. Due primarily to legal and institutional

constraints, however, the point system may not function perfectly, and the conventional-FHA differential may exceed the equilibrium value. Since the FHA interest rate is not constrained in the downward direction, the differential should never depart from the market-determined equilibrium in the negative direction (i.e., the interest rate differential should never fall below that dictated by the market's valuation of the risk difference between the two types of loans). If we denote the equilibrium risk-related differential by  $p$ , then

$$i_{\text{CON}} - i_{\text{FHA}} \geq p$$

where  $i_{\text{CON}}$  is the interest rate on conventional loans and  $i_{\text{FHA}}$  is the Section 203 effective interest rate (i.e., including points). Note that  $p$ , itself, need not remain constant over time; but, instead, it will vary as the risk-related terms on Section 203 insured loans change in relation to conventional loans.

As long as the equality in the above relation holds, the differential will not influence the demand for Section 203 insurance (although the actual level of interest rates will, of course, affect the overall quantity of mortgage funds demanded). But, when the inequality holds due to imperfections in the point system, lenders will become unwilling to originate FHA-insured loans, and the volume of insurance written under the Section 203 program will fall. This means that we should expect to obtain a negative sign when the differential between the conventional and the FHA effective interest rates is incorporated as an explanatory variable in the Section 203 demand equations. This, along with the preceeding expectations concerning the signs of the coefficients

on the other loan contract term differentials will be tested in the empirical model of this study.

#### Other Factors that Serve to Differentiate the Section 203 Insurance Service

In completing our specification of the Section 203 demand equations, we add other factors that may serve to differentiate the Section 203 service in the default insurance market. For the most part, these factors represent program requirements that are specific to Section 203 coverage and are expected to have reduced the demand for this form of insurance. This sub-section describes these additional influences and the variables that will be used to represent them and makes explicit the hypothesized direction of impact on the demand for Section 203 insurance.

#### FHA mortgage limit

The nominal price of housing has, in general, tended to rise over time. Mortgages eligible for Section 203 insurance are, however, constrained by a legislated ceiling on the dollar amount insurable under this program. This ceiling is adjusted from time to time by Congress to reflect increases in housing prices. But, such increases are relatively infrequent (only five increases occurred from the second quarter of 1952 to the second quarter of 1974). Therefore, the Section 203 insurance program constantly runs the risk that the proportion of all mortgages falling above this ceiling will be increased through a general rise in housing prices that is unmatched by an increase in the legislated ceiling. As this occurs, the demand for Section 203 insurance should, *ceteris paribus*, decline.

In order to measure the effect of this factor, a variable will be constructed that measures the difference between the Section 203 mortgage limit and the average price of homes sold in the given quarter (either new or existing depending upon which equation it enters). The assumption here is that the distribution of housing prices about the average remains reasonably constant over time (although the distribution itself may move to the right as inflation increases all prices) so that the simple difference between the Section 203 limit and this average will reflect changes in the proportion of home sales falling within the Section 203 limit. By the argument presented above, we should expect a positive sign for the coefficient of this variable in the Section 203 demand equations.

#### FHA processing time

Once the mortgage origination process has begun and the insurance decision is made, an application must be filed for approval by the insurance supplier. In the private market, such approval is generally completed within a day. Approval from FHA, however, may take longer than this since additional red tape and requirements are placed on these loans and, consequently, result in a slower processing of applications. Such delays in issuing commitments to provide insurance constitute a disincentive to purchase Section 203 insurance to both the borrower and the lender; and, therefore, any increase in such delays should result in a decrease in the volume of insurance written under Section 203 (i.e., a leftward shift in the demand curve for Section 203 insurance).

In order to account for this influence in the regression equations, we will include the percent of applications received by FHA that are processed (i.e., on which a commitment is issued or rejected) within three days. By the argument presented above, our hypothesis is that a positive sign will result on the coefficient of this variable in the Section 203 demand equations.

There are two basic problems introduced by using this measure as an explanatory variable in the regression equation. The first--which we can correct for--is the simultaneity between volume of activity and processing time. As processing time rises, Section 203 loses business and volume declines; but, with fewer applications to process, the time required for processing should fall. Therefore, this variable is not truly exogenous in the model. Such simultaneity will be corrected for by utilizing a simultaneous estimation technique (two-stage least squares will be employed). The second problem--which cannot be corrected for--is the imperfection with which this variable measures the desired effect. In measuring the percent of cases processed within three days, all applications that are incorrectly filled out are excluded. In other words, processing time begins with the receipt of a perfectly filled out application, but demand may respond to the difficulty in filling out such an application. This introduces the errors-in-variables estimation problem and could result in a biased estimate of the coefficient of processing time. Consequently, some qualifications concerning this coefficient may be in order.

HUD reorganization

The reorganization of the Department of Housing and Urban Development in November, 1969, and the splitting of FHA's various functions related to the provision of insurance (underwriting, property disposition, legal services, etc.) could, quite possibly, have contributed to the decline in Section 203 insurance volume (Bazan, 1974). However, given the supply mechanism employed by FHA, this effect must (as previously pointed out) have operated through a shift in the demand schedule for Section 203 insurance. Given the timing of both the reorganization and the downward turn in Section 203 activity, one could easily commit the fallacy of *post hoc ergo propter hoc*. That is, we must take care not to attribute cause merely on the basis of temporal ordering. We should, instead, inquire as to the mechanism through which the reorganization could conceivably have influenced the demand for Section 203 insurance.

This mechanism is primarily found in the length of time required by FHA insuring offices to process applications which, in turn, influences the demand for Section 203 insurance. If, as a direct result of the reorganization, inefficiencies were generated within FHA that caused increasing delays in processing applications, then we should (as discussed earlier) expect an ensuing decline in the demand for Section 203 insurance.<sup>9</sup> This effect is, consequently, already captured in our

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<sup>9</sup> Obviously, such inefficiencies may generate increases in the costs of providing insurance (such as the efficiency with which acquired properties are disposed of); but these should not, by themselves, affect the demand for Section 203 insurance. They will, instead, affect the actuarial soundness of the insurance fund and the overall adequacy of the prescribed premium rate.

processing time variable discussed previously and will not require an additional explanatory variable in the equations determining the volume of Section 203 insurance activity. The empirical test of the reorganization argument will come more directly through our specification and estimation of the equation determining FHA processing time which is discussed more fully later. In that equation, a binary variable will be included to represent the reorganization. This variable will be defined to be zero prior to the reorganization and one after. So defined, we should observe a negative sign for the coefficient of this variable as reorganization contributes to processing delays which, in turn, leads to a lower percent of applications processed within three days. This will constitute our test of the reorganization hypothesis.<sup>10</sup>

#### Secondary market activity in FHA insured loans

FHA-insured mortgages, along with conventional mortgages, are bought and sold by investors and originators in the secondary mortgage market. An increase in the demand for FHA-insured loans in this market should increase both the yield and the liquidity of such mortgages. This, in turn, should increase the relative attractiveness of FHA insurance to the mortgagee; and, consequently, it will result in an increase in the demand for Section 203 insurance.

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<sup>10</sup> A caveat is in order concerning the ability of an empirical model to test directly the entire reorganization argument. Horace Bazan, in his study of FHA (1974), hypothesizes that if it had not been for the reorganization, FHA administrators would have been better equipped to respond to other exogenous causes of declining volume; and, FHA would, therefore, never have been allowed to experience a decline of the magnitude witnessed in recent years. Obviously, this "ability to respond" argument constitutes an essentially untestable hypothesis and will, therefore, not be dealt with in the present study. It may, however, be entirely correct.

Demand for FHA-insured mortgages in the secondary market arises primarily from the purchase of such loans by the Federal National Mortgage Association (FNMA), the Government National Mortgage Association (GNMA), and the Federal Home Loan Mortgage Corporation (FHLMC). Data on the net purchases of FHA-insured loans by these three entities will be summed and included as a single explanatory variable in the regression equations explaining the volume of FHA activity. This is, of course, equivalent to assuming the marginal effect of a secondary market purchase to be the same regardless of the institution purchasing (usually for resale) the loan. The hypothesized sign of the coefficient of this variable is, of course, positive with more secondary market purchases of FHA loans leading to a larger volume of Section 203 insured loans being originated.

#### FHA processing requirements

The imposition of additional eligibility requirements over time on subdivisions seeking FHA approval creates increasing burdens on builders seeking to make homes available with FHA insured financing. The most important requirements in this regard have been the: (1) A-95 Review Requirement that requires builders to obtain approval from local planning agencies for proposed projects; (2) Environmental Clearance that requires builders to prepare and submit environmental impact statements of varying complexity for projects of varying size; and (3) Affirmative Marketing requirements that require the builder to submit detailed plans for advertising of proposed projects in order to attract minority buyers. These, of course, have their effect only on the insurance of new homes and should not influence the insurance of existing units.

In the insurance of the former, however, the effect of these requirements should be to reduce the relative attractiveness of Section 203 insurance compared to other insurance plans available since similar requirements are not imposed on these other plans.

These requirements have been imposed over time in a discrete, discontinuous fashion and will, therefore, be somewhat difficult to account for in an empirical analysis with time series data. Binary variables (which are defined to be equal to one after the imposition of each additional requirement and zero before) may be used in attempting to capture the effect of these requirements; but, since the requirements themselves were all introduced within a three-year period from 1969 to 1972, such variables would be extremely collinear and would make estimation of their separate influences quite difficult. Therefore, a single binary variable was employed that was set equal to one after the first quarter of 1972 and zero before that time. Obviously, interpretation of the coefficient of this variable will be somewhat ambiguous. It will essentially pick up the influence of all three processing requirements plus any other institutional changes that occurred around that period. Therefore, the marginal influence of each one of these factors was not estimated, but their total combined effect was, hopefully, captured in this single variable. Since all of these factors should lead to a decrease in the demand for Section 203 insured loans, the sign of the coefficient should be negative in the FHA equation for new units.

Housing starts as a proxy for overall housing and mortgage market activity

Finally, the demand for Section 203 insurance will be influenced by the overall level of activity in the housing and mortgage markets. This is due to the derived nature of the demand for mortgage insurance and the demand for mortgage funds. Both of these demands have as their ultimate source the demand for housing services. Consequently, we include single-family housing starts as a proxy variable for this overall level of activity in the Section 203 demand equations. The *a priori* expectation was, of course, that the coefficient of this variable would be positive with a greater level of activity increasing the demand for Section 203 insurance.

Consideration of all of the factors listed above leads to the following specification of the Section 203 demand equation for new units:

$$\begin{aligned}
 (4) \quad \text{FHAN} = & b_{4.0} + b_{4.1} (\text{PROC}) + b_{4.2} (\text{PMI}) + b_{4.3} (\text{VAN}) \\
 & + b_{4.4} (\text{SUBN}) + b_{4.5} (\text{TRM}) + b_{4.6} (\text{LTV}) \\
 & + b_{4.7} (\text{I}) + b_{4.8} (\text{SEC}) + b_{4.9} (\text{LIMN}) + b_{4.10} (\text{D}) \\
 & + b_{4.11} (\text{STS}) + e_4
 \end{aligned}$$

Variables entering this equation that have not been defined previously are:

- FHAN = the number of new single-family units insured by FHA under the Section 203 program;
- PROC = the percent of FHA single-family applications on which a commitment to insure or denial was issued within three days of receipt of the application, averaged over all insuring offices;
- VAN = the number of new single-family units guaranteed by the Veterans Administration;

- SUBN = the number of new single-family units insured by FHA under its subsidy programs (primarily Section 235);
- TRM = the difference between the average term to maturity on Section 203 insured loans and conventionally financed loans;
- LTV = the difference between the average loan-to-value ratio on Section 203 insured loans and conventionally financed loans;
- I = the difference between the average interest rate on conventionally financed loans and the average effective interest rate on FHA insured loans;
- SEC = net secondary market purchase (gross purchases minus gross sales) of FHA insured mortgages by FNMA, GNMA, and FHLMC in constant dollars;
- LIMN = the difference between the mortgage limit on Section 203 insured loans and the average price of new homes sold;
- D = a binary variable that is set equal to zero prior to the second quarter of 1972 and is equal to one thereafter intended to pick up the gross effects of FHA processing requirements;
- STS = single-family, non-farm housing starts. It is employed throughout as a proxy variable for the overall level of housing market activity; and
- $e_4$  = random variable

PMI was defined in equation (3) above, and  $b_{4.0}$ , ...,  $b_{4.11}$  are the parameters to be estimated.

With regard to the hypotheses that have been developed concerning the signs of these parameters, the *a priori* expectation is that  $b_{4.1}$ ,  $b_{4.5}$ ,  $b_{4.6}$ ,  $b_{4.8}$ ,  $b_{4.9}$ , and  $b_{4.11}$  will be positive and  $b_{4.2}$ ,  $b_{4.3}$ ,  $b_{4.4}$ ,  $b_{4.7}$ , and  $b_{4.10}$  will be negative. Section 203 volume on new units should increase with increases in the percent of cases processed within three days ( $b_{4.1} > 0$ ), with increases in the relative liberalness of Section 203 loans ( $b_{4.5} > 0$  and  $b_{4.6} > 0$ ), with increases in

secondary market purchases of FHA insured loans ( $b_{4.8} > 0$ ), with higher mortgage limits relative to housing prices ( $b_{4.9} > 0$ ), and with increases in overall housing activity ( $b_{4.11} > 0$ ). Volume should decrease with increases in the volume of insurance written by alternative suppliers of default coverage ( $b_{4.2} < 0$ ,  $b_{4.3} < 0$ , and  $b_{4.4} < 0$ ), with increases in the conventional minus FHA interest rates ( $b_{4.7} < 0$ ), and with the addition of extra processing requirements ( $b_{4.10} < 0$ ). No hypothesis exists concerning the sign of  $b_{4.0}$ .

Given our interpretation of the factors determining PMI, VAN, and SUBN (i.e., that a situation of excess demand characterizes the markets for these types of coverage), the only right-hand endogenous variable in this equation is PROC. Because of the simultaneity between this variable and FHAN, however, it was necessary to adopt a simultaneous equation estimation technique in fitting the relationship. Two-stage least squares was used.

Equation 5: Section 203  
Insurance Volume on Existing Units

The demand equation for Section 203 insurance on existing properties follows closely the demand for insurance on new units specified above. Therefore, the extended discussion of each variable with its rationale for inclusion in the equation will not be repeated here. The same basic arguments apply to the equation for existing units without modification. Essentially there are two minor differences. First, the processing requirements variable, D, does not enter this equation because these requirements are imposed only on new units (subdivisions particularly). And second, the variables employed refer only to

existing units where it was possible to make the distinction between property types. Thus, the demand for Section 203 insurance on existing units is specified as:

$$\begin{aligned}
 (5) \quad F_{HAE} = & b_{5.0} + b_{5.1} (PROC) + b_{5.2} (PMI) + b_{5.3} (VAE) \\
 & + b_{5.4} (SUBE) + b_{5.5} (TRM) + b_{5.6} (LTV) + b_{5.7} (I) \\
 & + b_{5.8} (SEC) + b_{5.9} (LIME) + b_{5.10} (STS) + e_5
 \end{aligned}$$

Variables entering this equation that have not been defined previously (i.e., those for which disaggregation by property type was feasible) are:

$F_{HAE}$  = the number of existing single-family units insured by FHA under the Section 203 program;

$VAE$  = the number of existing single-family units guaranteed by the Veterans Administration;

$SUBE$  = the number of existing single-family units insured by FHA under its subsidy programs (primarily Section 235);

$LIME$  = the difference between the mortgage limit on Section 203 insured loans and the average price of existing homes sold; and

$e_5$  = a random variable.

All other variables were defined above, and  $b_{5.0}, \dots, b_{5.10}$  are the parameters to be estimated.

Our hypotheses concerning the signs of these parameters are that  $b_{5.1}, b_{5.5}, b_{5.6}, b_{5.8}, b_{5.9}$ , and  $b_{5.10}$  will be positive and  $b_{5.2}, b_{5.3}, b_{5.4}$ , and  $b_{5.7}$  will be negative. Verbalization of these hypotheses follows that given for the Section 203 equation for new units and is, therefore, not repeated.

Equation 6: Processing Time of FHA Applications

This equation, the final behavioral equation of the model, determines the processing time on FHA applications (as measured by the percent of cases on which processing is completed within three days of receipt of the insurance application). Its specification is included in the model for two reasons. First, the hypothesis was expressed in a preceding section that the 1969 reorganization of the Department of Housing and Urban Development served to increase processing time which, in turn, served to reduce the demand for Section 203 insurance and, thereby, contributed to the decline in activity under this program. It is necessary, in order to test the first part of this hypothesis, that a behavioral equation be estimated with processing time as the dependent variable. Second, as was pointed out above, one would expect that Section 203 volume and processing time are determined simultaneously. Therefore, processing time should be made endogenous to the model so that the estimation procedure can allow for this simultaneity. While such estimation may, of course, be carried out without actually specifying the functional form of the processing time relationship, it does require that all exogenous variables entering this relationship be included in the reduced form equations. Consequently, little additional effort is required to fit the structural equation; and, by so doing, we can subject the hypothesis above to empirical verification.

The average amount of time required to process FHA single-family applications (the time lapse between receipt of application and issuance of commitment to insure or denial) is postulated as being functionally related to three variables. First, we hypothesize that

processing time will increase as the number of loans insured increases; and, since insurance volume is, in turn, hypothesized to be influenced by processing time, the two are determined simultaneously. Second, processing time should decrease as staffing is increased in terms of the number of man-years per application available in FHA for single-family processing. And third, processing time is hypothesized to have increased as a result of the 1969 reorganization. Together, these considerations lead us to the following specification of the FHA processing time equation:

$$(6) \quad \text{PROC} = b_{6.0} + b_{6.1} (\text{FHAT}) + b_{6.2} (\text{LOAD}) + b_{6.3} (\text{REOR}) \\ + e_6$$

The variables in this equation are defined as:

FHAT = the total number of single-family units (both subsidized and unsubsidized) insured by FHA in the given period;

LOAD = the number of man-years expended in initial processing of FHA single-family applications divided by the total number of single-family applications received (i.e., man-years per application);

REOR = a binary variable that is set equal to zero prior to the first quarter of 1970 and is equal to one thereafter. It is intended to pick up the influence of the 1969 reorganization on the speed with which applications are processed; and

$e_6$  = a random variable.

PROC was defined previously, and  $b_{6.0}$ , ...,  $b_{6.3}$  are the parameters to be estimated.

With regard to the anticipated signs of the parameters, it must be remembered that our measure of processing time, PROC, moves inversely

with the actual amount of time required to process applications. Consequently, the hypotheses developed above, if they are to be supported by the evidence, should result in  $b_{6.1}$  and  $b_{6.3}$  being negative and  $b_{6.2}$  positive. The percent of cases processed within three days should decrease with increasing volume and the reorganization and increase with staffing available per application. No *a priori* expectation existed concerning  $b_{6.0}$ . And, since FHAT and PROC are determined simultaneously, two-stage least squares were employed to estimate the parameters.<sup>11</sup>

#### Equation 7: FHA Subsidy Programs Identity

The following equation is true by definition and, therefore, constitutes an identity:

$$(7) \quad \text{SUB} \equiv \text{TOT} - \text{FHAN} - \text{FHAЕ} - \text{VA} - \text{PMI}$$

All variables in this identity have been previously defined and there are no hypotheses embodied in it. Also, since there are no unknown parameters and no stochastic elements involved, estimation need not be carried out. The equation is merely written to complete our description of the default insurance market.

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<sup>11</sup> Actually, only part of that FHAT variable is endogenous in this equation--the Section 203 portion of total volume. Subsidy program volume should be relatively insensitive to processing time variations. As a result, the two-stage procedure was employed by subtracting actual Section 203 volume from total FHA volume and adding predicted Section 203 volume back to the total, where predicted volume was generated from the reduced form equations for Section 203. Then, application of ordinary least squares to the equation with this predicted FHAT variable would be analogous to two-stage least squares estimation. It should be noted, however, that the estimates of the standard errors of the coefficients of this equation would not be exactly the same as those produced by direct estimation by two-stage least squares since the predicted values of FHAT would be used in calculating them.

### Summary

The set of equations that constitutes the complete empirical model for this study is given by:

$$(1) \quad \text{TOT/ORIG} = b_{1.0} + b_{1.1} (\text{LFHA}) + b_{1.2} (\text{TFHA}) + b_{1.3} (\text{VET}) \\ + b_{1.4} (\text{SD}) + b_{1.5} (\text{PMIA}) + e_1$$

$$(2) \quad \text{VA} = b_{2.0} + b_{2.1} (\text{VET}) + e_2$$

$$(3) \quad \text{PMI} = b_{3.0} + b_{3.1} (\text{PMIA}) + b_{3.2} (\text{PMIA1}) + b_{3.3} (\text{PMIA2}) \\ + b_{3.4} (\text{PMIA3}) + b_{3.5} (\text{PMIA4}) + b_{3.6} (\text{PMIA5}) \\ + b_{3.7} (\text{PMIA6}) + b_{3.8} (\text{PMIA7}) + b_{3.9} (\text{PMIA8}) \\ + b_{3.10} (\text{PMIA9}) + b_{3.11} (\text{PMIA10}) + b_{3.12} (\text{PMIA11}) \\ + e_3$$

$$(4) \quad \text{FHAN} = b_{4.0} + b_{4.1} (\text{PROC}) + b_{4.2} (\text{PMI}) + b_{4.3} (\text{VAN}) \\ + b_{4.4} (\text{SUBN}) + b_{4.5} (\text{TRM}) + b_{4.6} (\text{LTV}) + b_{4.7} (\text{I}) \\ + b_{4.8} (\text{SEC}) + b_{4.9} (\text{LIMN}) + b_{4.10} (\text{D}) \\ + b_{4.11} (\text{STS}) + e_4$$

$$(5) \quad \text{FHAЕ} = b_{5.0} + b_{5.1} (\text{PROC}) + b_{5.2} (\text{PMI}) + b_{5.3} (\text{VAЕ}) \\ + b_{5.4} (\text{SUBЕ}) + b_{5.5} (\text{TRM}) + b_{5.6} (\text{LTV}) + b_{5.7} (\text{I}) \\ + b_{5.8} (\text{SEC}) + b_{5.9} (\text{LIME}) + b_{5.10} (\text{STS}) + e_5$$

$$(6) \quad \text{PROC} = b_{6.0} + b_{6.1} (\text{FHAT}) + b_{6.2} (\text{LOAD}) + b_{6.3} (\text{REOR}) \\ + e_6$$

$$(7) \quad \text{SUB} = \text{TOT} - \text{FHAN} - \text{FHAE} - \text{VA} - \text{PMI}$$

And the hypothesized signs of the coefficients to be estimated for each equation are:

$$(1) \quad b_{1.j} > 0 \quad j = 0, \dots, 5;$$

$$(2) \quad b_{2.1} > 0;$$

$$(3) \quad b_{3.j} > 0 \quad j = 1, \dots, 12;$$

$$(4) \quad b_{4.1} > 0; b_{4.2} < 0; b_{4.3} < 0; b_{4.4} < 0; b_{4.5} > 0;$$

$$b_{4.6} > 0; b_{4.7} < 0; b_{4.8} > 0; b_{4.9} > 0; b_{4.10} < 0;$$

$$b_{4.11} > 0;$$

$$(5) \quad b_{5.1} > 0; b_{5.2} < 0; b_{5.3} < 0; b_{5.4} < 0; b_{5.5} > 0;$$

$$b_{5.6} > 0; b_{5.7} < 0; b_{5.8} > 0; b_{5.9} > 0; b_{5.10} > 0;$$

$$(6) \quad b_{6.1} < 0; b_{6.2} > 0; b_{6.3} < 0.$$

The following chapter presents the results obtained from the estimation of this model and interprets these results.

CHAPTER VI  
THE EMPIRICAL MODEL:  
ESTIMATION AND INTERPRETATION

Data Employed, Estimation Techniques, and Qualifications

The data that have been collected to carry out the estimation of this empirical model are national quarterly observations over the period from the fourth quarter of 1952 through the second quarter of 1974, yielding a total of 87 observations. Documentation of these data is given in Appendix 2 at the end of the study. The three major sources of these data are the *Quarterly National Housing Market Data Bank* assembled by Eugene Brady for the Federal Home Loan Bank Board (1971), the *Data Resources Incorporated National Data Bank*, and the Federal Housing Administration's Statistics Division.

A problem was encountered regarding the series used to measure FHA single-family processing time, PROC. This series is only available from the third quarter of 1965. Restricting our sample to the period over which this series is available would result in a loss of 51 observations on all other variables in the model and, thereby, the neglect of a considerable amount of information. Such a loss would reduce the overall efficiency of the estimation procedure and increase the probability of a Type II error. In order to avoid this loss and to be able to employ the larger sample in fitting the two Section 203 demand equations, it was necessary to estimate the processing time reduced form equation first using the smaller sample (36 observations) and predict

the values for this variable backward over the period for which actual observations were unavailable. Then, the complete series (predicted before the third quarter of 1965 and actual thereafter) was employed in estimating the two Section 203 equations, thereby making it feasible to utilize the additional information contained in the larger sample.<sup>1</sup>

Such a practice obviously introduced the errors-in-variables problem which can lead to biased estimates of the structural coefficients. The tradeoff faced in this situation, then, may be described as one of increasing estimation efficiency at the expense of possible biasedness. Given the large number of variables included in the Section 203 equations and the extent to which the sample size would have to be reduced in order to avoid this source of bias, the decision was made to opt for the increased efficiency of the larger sample. The problem was, of course, constrained to equations 4, 5, and 6 of the model.

The estimation techniques that were applied to the various equations in the model differed according to the particular problems that were encountered. Equations 1 and 2 contain no endogenous variables on the right-hand side and are not specified with a distributed lag structure. Therefore, these equations were initially estimated using ordinary least squares. The Durbin-Watson statistic for the second equation, however, indicated the presence of positive first-order serial correlation which, if uncorrected, would result in inefficient estimates. Therefore, a generalized least squares estimation procedure

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<sup>1</sup>The predicted values for PROC remain well within the range of observed values for this variable. Also, as a check, the smaller sample was employed in fitting the Section 203 equations, and no serious divergencies emerged. Consequently, the results obtained by employing the larger sample are presented in this study.

was adopted for this equation. Since the first-order coefficient of autocorrelation was unknown, it had to be estimated.<sup>2</sup> Consequently, the resulting estimates of the structural coefficients of this equation constitute feasible Aitken's estimates. Therefore, they will exhibit the asymptotic property of consistency. The Durbin-Watson statistic for the first equation, however, fell within the indeterminant range. Therefore, the ordinary least squares estimates of the coefficients of this equation were retained. As a result, these estimates should exhibit the small sample properties of efficiency and unbiasedness.

Equation 3 also contains no right-hand endogenous variables, but it is specified with a polynomial distribution lag structure of the Almon variety in which we have constrained the polynomial to be of the second degree (allowing for one turning point only in the structure of the lagged effects). Here too, the Durbin-Watson statistic from the initial estimation results indicated the presence of positive first-order serial correlation. Therefore, the Cochrane-Orcutt procedure was also applied to the distributed lag equation so that feasible Aitken's estimates were obtained for the coefficients of this equation also. As a result, these estimates will also exhibit the asymptotic property of consistency. Also, since private mortgage insurance volume (and private mortgage insurance availability) remained at zero until 1957, the first seventeen observations of our sample were dropped for the estimation of this equation. With both the left-hand and right-hand variables identically equal to zero over this part of the sample, the inclusion of

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<sup>2</sup>The Cochrane-Orcutt iterative technique was employed to arrive at an estimate of this coefficient (see Johnston, 1972, p. 262).

these observations in the estimation would distort the estimates of the slope coefficients.

Finally, equations 4, 5, and 6 contain right-hand endogenous variables so that a simultaneous equation estimation technique becomes appropriate. Investigation of the rank and order conditions for identifiability of these three equations was carried out under the maintained assumption that the coefficients of the system hypothesized to be different from zero are, indeed, significantly different from zero and that those hypothesized to be equal to zero are not significantly different from zero. This is the test of the necessary and sufficient conditions for identification under the assumption of zero coefficients outlined by Kmenta (1971, pp. 544-545). The results indicated that all three equations are over-identified. Therefore, the two-stage least squares estimation procedure was adopted for these equations.<sup>3</sup> As a result, these estimates will also exhibit the asymptotic property of consistency. Therefore, with the exception of equation 1, none of the estimated coefficients will exhibit the small sample properties of unbiasedness or efficiency. Consequently, any statistical test that one might wish to carry out on the structural coefficients of equations 2 through 6 must be interpreted as being asymptotic in nature.

Prior to presenting the estimation results, a word of caution must be expressed. The coefficients given below must be interpreted as rough approximations at best. They should not be accepted as precise measures of constant, exact relationships. The degree of accuracy

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<sup>3</sup>See footnote 11 of the preceding chapter for an explanation of the technique employed to arrive at two-stage least squares estimates for equation 6.

exhibited by these estimates depends upon a myriad of factors, some of which we can know very little about. Most obviously, the precision of the estimated coefficients in describing the actual relationships involved is dependent upon the overall accuracy of the data that comprise the sample. Concern has already been expressed about the adequacy of one of the series employed (the processing time variable). Others, however, are subject to similar qualifications, particularly the mortgage origination series, interest rate series, and private mortgage insurance volume series. Also, some of the factors that have possibly affected the variables that are endogenous to the model were qualitative in nature and, as a result, could only be incorporated through the use of binary (intercept shift) variables. Such variables are rather crude, and particularly in a time series model, they are liable to pick up the effects of any excluded influences that occur contemporaneously. And finally, as mentioned in Chapter II, the overall quality of extant housing and mortgage market data is notoriously poor, particularly in the earlier periods such as the 1950's. The net result of these considerations is to increase the errors-in-variables estimation problem which, in turn, increases the likely bias of the estimated coefficients.

Further qualification is required when one admits possible nonlinearities in the relationships hypothesized to exist and the likelihood that the structural coefficients have not remained constant over the entire sample period. And finally, it is quite likely that the use of national data has resulted in the well-known aggregation bias problem. This last source of bias will exist in the estimates obtained unless the extremely unlikely condition is met that the structural coefficients and functional form of the relationships hypothesized to

exist are precisely the same for all micro-areas of the country over which our data are aggregated (Green, 1964, pp. 99-106).

Hopefully, these rather severe qualifications do not destroy the usefulness of the estimation results but, rather, guard one against their unwarranted misuse. The value of the empirical exercise lies in the additional information that it may shed on the basic issues that the model is designed to address. Fundamentally, such information lies in the confirmation or contradiction of the theoretical conclusions that have been reached regarding these issues, i.e., in providing an inductive test of the deductive process that generated these conclusions (Tintner, 1968, p. 56). The interpretation provided in the following section will follow this basic view of the role of empirical research in economics.

#### Estimation Results and Interpretation

The estimated relationships that result from the application of the procedures described above are now presented. The notation employed is the following:  $n$  is the number of observations utilized in the estimation; S. E. is the estimated standard error of the regression;  $F$  is the  $F$ -statistic for the equation calculated from the transformed variables employed to correct for the serial correlation in equations 2 and 3 with the degrees of freedom in parentheses (not given for equations 4, 5, and 6);  $R^2$  is the coefficient of determination (uncorrected for degrees of freedom) calculated from the transformed variables in equations 2 and 3 (not presented for equations 4, 5, and 6 because it is not directly relevant to two-stage least squares estimation results);  $\hat{\rho}$  is the estimated first-order autocorrelation coefficient (for equations

2 and 3); and the estimated standard errors (asymptotic for equations 2 through 6) of the respective structural coefficients are given in parentheses under each coefficient.<sup>4</sup> The following relationships result from this estimation:

$$\begin{aligned}
 (1) \quad \text{TOT/ORIG} &= 71.0853 - 0.7884 (\text{LFHA}) + 0.0471 (\text{TFHA}) \\
 &\quad (25.1110) \quad (0.3165) \quad (0.8208) \\
 &\quad + 0.0004 (\text{VET}) + 4.7954 (\text{SD}) + 11.0117 (\text{PMIA}) \\
 &\quad (0.0001) \quad (1.0396) \quad (3.7341)
 \end{aligned}$$

$$n = 87$$

$$\text{S. E.} = 2.8432$$

$$F(5, 81) = 34.2045$$

$$R^2 = 0.6786$$

$$\begin{aligned}
 (3) \quad \text{VA} &= 27988.7185 + 2.6023 (\text{VET}) \\
 &\quad (29738.1900) \quad (1.8886)
 \end{aligned}$$

$$n = 86$$

$$\text{S. E.} = 14208.1$$

$$F(1, 84) = 357.8726$$

$$R^2 = 0.8099$$

$$\hat{\rho} = 0.8809$$

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<sup>4</sup>Significance levels are given in Appendix 1 of this study. They are not presented in the text because of the questionable practice of carrying out multiple tests on a single sample. Readers wishing to know the significance level of a particular coefficient, therefore, are referred to the appendix.

$$\begin{aligned}
 (3) \quad \text{PMI} = & -420558.6297 - 29050 \text{ (PMIA)} + 9610 \text{ (PMIA1)} \\
 & \quad \quad \quad (69220) \quad \quad \quad (47450) \\
 & + 40740 \text{ (PMIA2)} + 64360 \text{ (PMIA3)} + 80450 \text{ (PMIA4)} \\
 & \quad \quad \quad (37390) \quad \quad \quad (37780) \quad \quad \quad (41730) \\
 & + 89020 \text{ (PMIA5)} + 90070 \text{ (PMIA6)} + 83600 \text{ (PMIA7)} \\
 & \quad \quad \quad (44090) \quad \quad \quad (42930) \quad \quad \quad (38070) \\
 & + 69610 \text{ (PMIA8)} + 48090 \text{ (PMIA9)} + 19060 \text{ (PMIA10)} \\
 & \quad \quad \quad (31270) \quad \quad \quad (29070) \quad \quad \quad (40900) \\
 & - 17500 \text{ (PMIA11)} \\
 & \quad \quad \quad (65470)
 \end{aligned}$$

$$n = 57$$

$$\text{S. E.} = 12843.4$$

$$F(12, 44) = 31.6237$$

$$R^2 = 0.8961$$

$$\hat{\rho} = 0.8905$$

$$\begin{aligned}
 (4) \quad \text{FHAN} = & 198.5872 - 465.4113 \text{ (PROC)} - 0.0706 \text{ (PMI)} \\
 & \quad \quad \quad (34587.5573) \quad (266.7015) \quad \quad \quad (0.0562) \\
 & - 0.0722 \text{ (VAN)} - 0.5349 \text{ (SUBN)} + 1484.8154 \text{ (TRM)} \\
 & \quad \quad \quad (0.0275) \quad \quad \quad (0.2065) \quad \quad \quad (764.5105) \\
 & + 1754.6223 \text{ (LTV)} - 2399.7518 \text{ (I)} + 2.3357 \text{ (SEC)} \\
 & \quad \quad \quad (323.3988) \quad \quad \quad (2159.7312) \quad \quad \quad (1.4153) \\
 & + 0.2595 \text{ (LIMN)} - 2834.9750 \text{ (D)} + 13684.5238 \text{ (STS)} \\
 & \quad \quad \quad (0.2759) \quad \quad \quad (5337.9418) \quad \quad \quad (4007.2573)
 \end{aligned}$$

$$n = 87$$

$$\text{S. E.} = 4041$$

$$\begin{aligned}
 (5) \quad FHAE &= 31375.1970 + 53.0163 (PROC) - 0.5118 (PMI) \\
 &\quad (57068.1026) \quad (419.4966) \quad (0.0979) \\
 &\quad - 0.3298 (VAE) - 1.0623 (SUBE) + 1489.7717 (TRM) \\
 &\quad (0.1471) \quad (1.1344) \quad (2569.2259) \\
 &\quad - 3176.6337 (LTV) - 20884.4941 (I) + 5.5557 (SEC) \\
 &\quad (1076.8106) \quad (6335.9194) \quad (4.3450) \\
 &\quad + 4.2575 (LIME) + 53062.7643 (STS) \\
 &\quad (0.9766) \quad (12702.3642)
 \end{aligned}$$

$$n = 87$$

$$S. E. = 14029$$

$$\begin{aligned}
 (6) \quad PROC &= 125.7520 - 0.0002 (FHAT) - 556.1184 (LOAD) \\
 &\quad (13.5603) \quad (0.0001) \quad (463.8870) \\
 &\quad - 19.9460 (REOR) \\
 &\quad (3.6809)
 \end{aligned}$$

$$n = 36$$

$$S. E. = 9.72$$

Given the size of this empirical model, it will be convenient to discuss these estimation results on an individual equation basis. Particular attention will be devoted to the results obtained for the two Section 203 equations.

#### Equation 1: Total Insurance Volume

The results for this equation provide rather strong support for the hypothesis that supply constraint shifts in the VA, private, and subsidy markets are directly related to the volume of total mortgage insurance written out of a given volume of originations. All of the coefficients for the variables used to reflect these supply constraints

shifts are of the hypothesized sign and their standard errors are relatively small. Also, the variable coefficient relating originations to insurance was calculated from the estimated coefficients via expression (1b) in Chapter V, and it was found to remain positive over all observations as hypothesized. Its average value over the sample period is 12.38. Therefore, it does appear that the size of the overall market for default insurance is directly related to the level of activity being carried out in the mortgage market. This result is, of course, not surprising given the derived nature of the demand for mortgage insurance.

The results relating to the effect of financing term variations on the proportion of mortgage originations insured, however, are not very encouraging. The sign of the coefficient for loan-to-value ratio variations is the opposite of that hypothesized, and the standard error of the coefficient for term to maturity variations is relatively large. These discouraging results for the financing terms hypothesis could, of course, stem from several different kinds of estimation problems. First, a degree of collinearity exists between LFHA and TFHA with the simple correlation coefficient between these variables standing at 0.9347. Second, the degree of variation experienced by these two variables has not been extremely large over the sample period. The range of variation for LFHA was 83.7 to 95.3 over the observed values, and the range for TFHA was 21.7 to 31.7. And third, it is possible that the FHA terms do not accurately reflect the movement over time in the overall financing terms available on insured mortgages. To the extent that these unavoidable estimation problems have not determined the empirical results, however, we are forced to conclude that financing

term variations have been relatively unimportant in determining the proportion of mortgage originations that are insured over time. This, of course, does not deny the possibility that such terms have exerted an important influence on the allocation of total insurance volume among the various participants, especially between Section 203 and the private firms in the market, through their effect on product differentiation and substitutability.

#### Equation 2: VA Insurance Volume

The empirical results obtained from the estimation of this highly (perhaps overly) simplified specification provides weak support for the hypothesis that the supply constraint in the VA market is determined by the number of veterans that are eligible for the VA guarantee. The sign of the VET coefficient is as hypothesized and the (asymptotic) standard error of the coefficient is relatively small. While they do not provide a direct test of our maintained hypothesis that the VA market is characterized by a condition of excess demand throughout the sample period, these results do tend to increase one's confidence in the use of this hypothesis in the theoretical construct.

#### Equation 3: Private Insurance Volume

The results obtained from the second degree polynomial distributed lag structure imposed on this equation are encouraging. The coefficients of the lag structure increase for the six quarters following the relaxation of legal prohibitions against the selling of private insurance and then decline. With the exception of the coefficients for the unlagged effect and the eleventh quarter lagged effect, all estimates

are of the hypothesized sign. Also, the (asymptotic) standard errors are, in general, relatively small, particularly for the mid-range lagged effects. Therefore, the hypothesis that private mortgage insurance volume is determined by a combination of legal availability and (unobserved) contingency reserve accumulation received moderately strong support from this equation.

Here also, the maintained hypothesis of an effective supply constraint receives indirect support. And, since the private mortgage insurance availability index, PMIA, achieved its upper bound (equal to one) in the third quarter of 1973 and since the accumulation of contingency reserves sufficient to meet the market demand in a given state appears to be complete by the end of the third year following entry into the state, we may expect the supply constraint relating to the private national market to become ineffective by 1977. By the principle of Le Chatelier (Chapter IV and Samuelson, 1947, p. 38), this reduction in the number of rationed substitutes should result in an increase in the own price substitution effect of the demand for Section 203 coverage. Given the relative price of this coverage, the elimination of the private mortgage insurance supply constraint will also imply that Section 203 will continue to write default insurance only to the extent that its product is differentiated (by differences in coverage level, terms, etc.) from the coverage provided by the private firms in the market.

#### Equation 4: Section 203 Insurance Volume on New Units

This equation and the one to follow serve (along with the theoretical considerations that have led to them) as the primary source of

the conclusions reached in this study regarding the causal factors involved in the decline of insurance activity under the Section 203 program. Therefore, the detail that is devoted to the interpretation of these two equations will be greater than that afforded to other equations in the model. Since these Section 203 equations are quite similar in specification, we will discuss the new units equation in detail and then dwell on the existing units equation only to the extent warranted by differences in the empirical results obtained.

The first coefficient in this equation for which we have developed a hypothesis is the coefficient attached to the processing time variable, PROC. The resulting sign is in direct conflict with our hypothesis. The negative sign estimated by the equation implies that, holding everything else constant, Section 203 volume declines as the percent of cases processed within three days increases, i.e., faster processing leads to a loss of insurance volume. Also, the (asymptotic) standard error of this coefficient is relatively small. This result casts further doubt on the adequacy of the data series used to measure processing time fluctuations. But, to the extent that it can be believed, it also casts considerable doubt on the hypothesis that increases in FHA processing time contributed to the decline in activity.

All other signs in this equation are as hypothesized, and the overall accuracy of the parameter estimates (i.e., the relative size of the standard errors of the estimates) is encouraging. All three of the alternative suppliers of default insurance appear to have substituted for Section 203 coverage. This is inferred from the negative signs for PMI, VAN, and SUBN and the relatively small (asymptotic) standard errors of the coefficients of these three variables. From the relative sizes

of these coefficients, the private insurance and VA guarantees appear to have had approximately the same marginal effect on Section 203 volume written on new units (reducing this volume one unit for every thirteen units insured by them), and the subsidy programs appear to have exerted a larger marginal effect (reducing 203 volume on new units one unit for every two units insured). This, of course, does not imply that the subsidy programs contributed more to the actual decline since the total volume of activity under these programs was relatively small and confined to the post-1968 period with large declines in insurance activity under these subsidy programs occurring in 1973 and 1974. It does appear, however, that these programs were influential in reducing Section 203 volume during the period in which they were active.

The fact that the PMI coefficient is negative and estimated with a relatively small (asymptotic) standard error lends indirect support to the cream-skimming hypothesis. While a direct test of this hypothesis would require knowledge of the risk-related characteristics of the individual loans insured by the private firms in the industry, it is clear from the equation that the insurance volumes attained by these firms did come, at least partially, at the expense of the Section 203 program. An additional (though still indirect) test of the cream-skimming hypothesis will be provided at the end of this chapter.

The two relative financing term variables, TRM and LTV, both result in positive coefficients as was hypothesized, and the (asymptotic) standard errors estimated for these coefficients are relatively small. Thus, the empirical evidence from this equation supports the hypothesis that relative financing terms are an important determinant of the allocation of total default insurance market demand among the various

participants. It also supports the hypothesis that long run declines in the relative financing terms advantage of Section 203 insured mortgages have contributed to the declining insurance volume under that program. This appears to be particularly true of the declining difference between Section 203 and conventional loan-to-value ratios since the coefficient for this variable is larger and since the decline in the value of this variable has been larger also. The average loan-to-value ratio advantage of Section 203 insured loans declined 43 percent over the sample period, from a difference of 25.9 percentage points in 1952 to a 14.7 percentage point difference in 1974. Given the estimated coefficient, this decline in LTV implies an overall loss of 19,652 new units per quarter under Section 203. And, the difference between Section 203 and insured conventional loan financing terms (for which data are not available) are bound to have declined even more. As will be seen later, however, these results appear to be specific to the insurance of new units only. But, with respect to these units, the erosion of relatively more liberal financing terms under Section 203 does appear to have contributed to the declining volume of insurance activity.

The variable measuring the effective interest rate difference between conventional and Section 203 insured loans attains the hypothesized sign, but the estimated standard error is relatively large casting some doubt on the strength of the relationship between I and Section 203 insurance volume on new units. Thus, the empirical evidence fails to provide strong support for the hypothesis that a failure to adjust the fixed rate allowed on Section 203 loans has been an important cause of the declining volume of activity under this program. From this

result, we are inclined to conclude that the discount point system has served adequately to correct for non-market interest rate differences for the insurance of new units.<sup>5</sup>

Secondary market net purchases of FHA-insured loans carries a positive coefficient that is estimated with a relatively small standard error. Thus, the equation lends support to the hypothesis that purchases of FHA-insured mortgages by FNMA, GNMA, and FHLMC increase the demand for Section 203 coverage. Given the commitment process employed by these institutions in purchasing loans, this finding comes as little surprise (see Bartke, 1971). While these secondary market participants do not originate loans, the announcement that loans of a certain variety will be purchased encourages originators that sell to these institutions (particularly mortgage bankers) to initiate loans of the given type requested. Thus, the commitment process directly encourages the origination of particular kinds of loans, and the purchase of FHA-insured loans by secondary market institutions is almost equivalent to a direct demand for Section 203 coverage. Therefore, we conclude that secondary market activities have tended to support Section 203 volume over the sample period. In the absence of such activity, the decline in this volume would have been even more severe than that experienced.

Recent institutional changes that allow for secondary market purchases of privately insured mortgages by FNMA and FHLMC (in 1971) and GNMA (in 1973) should contribute to future declines in Section 203 volume as FHA's historical dominance in the secondary market is reduced.

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<sup>5</sup>This finding is in basic agreement with that of Lawrence Smith (1970). Note, however, that our conclusion here applied only to the effect of I on the insurance of new units. As will be seen in our discussion of equation 5 below, a stronger impact is found for the insurance of existing units.

It should be noted, however, that the higher percentage coverage provided under Section 203 may be of a much greater value to the secondary market investor. Often, such an investor is unfamiliar with both the property securing the mortgage and the mortgagor who is actually borrowing the funds. In many instances, he is located in a different region of the country. Because of these features of secondary market investment, the ultimate lender will be unable to assess the default risk on the mortgage instrument and, as a result, the extra coverage afforded on Section 203 loans may be relatively more important. An inquiry into the value of 100 percent coverage to secondary market investors would appear to be appropriate as the only source of such coverage continues to decline in the primary market. The policy implications of such an inquiry could be very important for national housing objectives.

The coefficient for the variable measuring the difference between the FHA mortgage limit and the average price of new homes sold has the hypothesized sign, but the standard error of the estimate is relatively large. The hypothesis that adjustment lags in the mortgage limit have contributed to the Section 203 decline in insurance written for new units does not, therefore, receive strong support from the empirical evidence. It should be pointed out, however, that a rather strong assumption is required in applying this measure to the hypothesis that was developed. That is, we were forced to assume that the distribution of housing prices remained constant except for an overall shift to the right so that the difference measured by LIMN would reflect the proportion of houses sold that were above the mortgage limit. It was not possible to obtain data on the actual proportion of homes sold that were priced above the limit over the whole sample period. Therefore, the

lack of stronger support for this new hypothesis may stem from the inadequacy with which the desired variable has been measured.

A similar conclusion applies to the binary variable intended to capture the effect of processing requirements (A95 Review, Environmental Clearance, and Affirmative Marketing). It, too, results in a coefficient of the hypothesized sign, but its standard error is also relatively large. Therefore, subject to the qualifications that were made explicit in Chapter V concerning the use of binary variables with time series data, we are forced to conclude that the addition of these requirements in the late 1960's and early 1970's resulted in an ambiguous (perhaps zero) effect on Section 203 volume.

Finally, the hypothesis that Section 203 volume is directly influenced by the overall level of activity in the housing market (from which the demands for mortgage funds and default insurance are derived) is supported by the positive sign of the coefficient on housing starts, STS. Given the relatively small (asymptotic) standard error with which this coefficient is estimated, we can be fairly confident of this result. It should be recalled, however, that this variable should not be interpreted as the direct causal force at work since it is employed as a proxy variable only. But, the results in this and the following equation tend to indicate that the variable serves well in this role.

#### Equation 5: Section 203 Insurance Volume on Existing Units

The empirical evidence revealed in this equation is, for the most part, quite similar to that detailed in equation 4 above. Where the results are in basic agreement, one may hold the conclusions drawn with somewhat increased confidence. In such cases, the interpretation of

the findings will not be repeated here. Instead, since the estimated equations do diverge in some respects, this section will only point out the areas of possible conflict in results and attempt to reconcile such conflicts.

First, the processing time variable in the equation for existing units results in a coefficient of the hypothesized sign. The positive coefficient estimated here would imply that Section 203 demand responds positively to increases in the percent of cases processed within three days and, therefore, appears to contradict the conclusion drawn from equation 4 that increases in processing time did not contribute to the decline. The standard error of this estimated coefficient, however, is quite large and, as a result, no real conflict in results appears. Therefore, our conclusion concerning processing time is further supported by the results of this equation even though a positive sign is attained. None of the empirical evidence presented supports the hypothesis that processing delays were an important cause of decline.

Second, while the coefficient for the insurance volume of FHA's subsidized insurance programs maintains the hypothesized sign, the relative size of the estimated (asymptotic) standard error is disappointingly large. This result, however, is probably attributable to the relatively small amount of variation of existing unit insurance volume that was written under these programs over the sample period. In this period, there were 371,317 new units insured under these programs and only 97,165 existing units. Thus, unlike the Section 203 program under which the existing out-number the new units insured by a considerable margin, 'the subsidy programs' existing unit volume accounted for only 21 percent of the total. This confronts us with the

basic statistical problem of being unable to accurately measure the influence of something that has not varied sufficiently. Consequently, the large standard error may stem from the lack of sufficient variation in the insurance of existing units under the subsidy programs.

Third, the estimated coefficient for the loan-to-value ratio differential between FHA and conventional loans is the opposite of that obtained in the previous equation and to that hypothesized. Also, this coefficient is estimated with a relatively small (asymptotic) standard error. The only rationale that appears to exist for this result is that the Section 203 program resorted to increasing insurance volume on existing units (perhaps the more risky loans on central city properties) as conventional loan-to-value ratios increased relative to those available under Section 203. By so doing, the eventual decline in total insurance activity may have been delayed until increasing private mortgage insurance volume could be expanded to the insurance of existing units also. Such a conjecture would appear to receive support from the graphs presented in Chapter I. For the present, however, this explanation for the divergent result in the two equations must remain speculative. Again, the resolution requires data that are, at present, unavailable (such as disaggregated private mortgage insurance data broken down by property type and location).

Finally, both the interest rate differences and the mortgage limit variables attain signs that are in agreement with equation 4 and the theory developed in Chapter IV. The standard errors of these estimated coefficients, however, are much smaller in this equation. Therefore, we conclude that these factors were more influential in reducing Section 203 volume on existing units than they were in reducing activity on

new units. With regard to the interest rate variable, such a conclusion seems reasonable since individual sellers (on existing units) may be less capable of utilizing the point system to equate the legal FHA rate to the existing market rate than are developers or builders (on new units). That is, effective utilization of the point system may require greater expertise than can be expected from non-professional participants in the market. The smaller standard error for the coefficient of the mortgage limit variable, however, was not anticipated and, for the present, must remain anomalous.

#### Equation 6: FHA Processing Time

All of the hypotheses developed concerning the factors affecting single-family processing time on FHA-insured loans receive empirical support from this equation except for the staffing level per application variable. The coefficient for this variable is opposite in sign to that expected, although the relative size of its standard error casts some doubt on the true sign. The total volume variable and the reorganization variable, however, do attain the anticipated sign and they are estimated quite accurately (small standard errors). Therefore, it does appear that the 1969 reorganization did result in greater processing time on insured loans, decreasing the percent of cases processed within three days by almost twenty percentage points. Given the empirical results that were obtained in equations 4 and 5 above, however, it does not appear that this increased processing time was an important contributor to the declining volume of activity under the Section 203 program. There were other market-related events that appear to swamp the processing time effect.

An Empirical Test of the Joint  
Cream-Skimming Hypothesis

In Chapter V we concluded that cream-skimming on the part of the private mortgage insurers would lead to both a decline in the volume of insurance being written under Section 203 and a rise in the average claims rate being experienced on remaining Section 203 volume. The former conclusion received indirect support from equations 4 and 5 in the model detailed above. We now intend to empirically test the joint hypothesis from the cream-skimming argument (i.e., the effect of private mortgage insurance volume on Section 203 default rates).

The data employed in this test were available only for the 1957 to 1974 period and are annual in nature. Thus, the number of observations is quite limited. Also, in deriving a measure of the underwriting quality of the Section 203 insured loans, we used the total number of these loans entering default within three and, alternatively, four years after endorsement divided by the total number endorsed under Section 203 in the given year. The assumption here is that the distribution of defaults over time remains constant over year of endorsement shifting vertically with changes in risk so that a three or four year look into the future is sufficient to make inferences about the quality of all loans insured in any given year. This method for constructing the dependent variable for the empirical test, however, reduces the already small sample size by three observations, leaving the total period covered at 1957 through 1970 (i.e., 14 observations).

Due to the extremely small sample size, the number of explanatory variables must, obviously, be constrained. It was decided that, in determining the underwriting quality of Section 203 loans, three

variables would be employed. First, the volume of insurance written by the private mortgage insurance industry is included to test the cream-skimming hypothesis. If this hypothesis is to receive empirical support, the sign of the coefficient for this variable should be positive. Second, since the data are national and annual in nature, the rate of inflation and unemployment rate were included as the second and third explanatory variables in the equation. Given the theory of default behavior that was developed in Chapter IV, it is obvious that these two variables will operate to affect default probabilities through their (opposite) effects on property values. For a loan of given size and terms, the movements over time in the value of the mortgaged property can have an important impact on borrower equity and, thereby, default behavior. The hypotheses regarding these variables are, of course, that a higher rate of inflation will improve the underwriting quality of loans insured (i.e., reduce the average default rate) since equity will be accumulated at a faster rate; and that a higher rate of unemployment will increase the average default rate on insured loans by reducing overall housing demand and, thereby, property values. Then, the coefficient on the rate of inflation should be negative and the coefficient on the rate of unemployment should be positive.

Denoting the average foreclosure rate by FORC, private mortgage insurance volume by PMI, the rate of inflation by IN, and the rate of unemployment by UN, the following two equations were estimated with ordinary least squares (the first utilizing default terminations up to three years after endorsement and the second utilizing default terminations up to four years after endorsement to construct the dependent variable):

$$\begin{aligned} \text{FORC}_3 &= -1.3027 + 0.00003015 (\text{PMI}) + 0.01820 (\text{IN}) \\ &\quad (2.6416) \quad (0.00001412) \quad (0.21452) \\ &\quad + 0.60777 (\text{UN}) \\ &\quad (0.40225) \end{aligned}$$

$$n = 14$$

$$\text{S. E.} = 1.082$$

$$R^2 = 0.3186$$

$$\text{D. W.} = 1.1091$$

$$\begin{aligned} \text{FORC}_4 &= -1.4995 + 0.00003194 (\text{PMI}) - 0.02644 (\text{IN}) \\ &\quad (3.6079) \quad (0.00001929) \quad (0.29298) \\ &\quad + 0.8846 (\text{UN}) \\ &\quad (0.5494) \end{aligned}$$

$$n = 14$$

$$\text{S. E.} = 1.478$$

$$R^2 = 0.2698$$

$$\text{D. W.} = 1.0391$$

In both equations, the coefficient for PMI has the expected sign (i.e., the sign is in agreement with the cream-skimming hypothesis) and it is estimated with a relatively small margin of error. Therefore, the hypothesis that the private mortgage insurance industry has attracted the preferred risk customers from the Section 203 insurance program is supported. Our confidence in this conclusion, however, must be tempered by the fact that the small sample size employed in fitting the above equations forces us to exclude other factors that may have been important in explaining the underwriting quality of loans insured (i.e., the equation may suffer from underspecification and, as a result, the estimates obtained may be biased). Also, the sample period, by

necessity, excludes the 1971 to 1974 period during which time the private mortgage insurance industry experienced its fastest growth. Thus, due to the manner in which our dependent variable was constructed, we are denied use of the period of greatest variation in PMI.

Also, note that the unemployment rate variable has the expected sign and is estimated with a relatively small standard error in both equations. And also, note that the inflation rate variable has the wrong sign in the first equation and is estimated with a relatively large standard error in both equations. The  $R^2$  in each equation is fairly low (.32 in the first and .27 in the second) but this result is to be expected given the small number of explanatory variables included and the highly stochastic nature of default behavior.<sup>6</sup> And finally, the Durbin-Watson statistic for both equations falls within the indeterminate range.

We conclude, therefore, that while our empirical investigations have served to increase our overall confidence in the accuracy of the cream-skimming hypothesis, direct verification must await more detailed and disaggregated data on the actual loans insured by the private firms in the industry.

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<sup>6</sup> Notice that, if default behavior were largely deterministic with little or no unexplained variance, then there would be little need for default insurance. It is the importance of the stochastic element that determines the inherent risk that, with lenders' risk aversion, generates the demand for insurance.

## CHAPTER VII SUMMARY AND CONCLUSIONS

### Summary of the Study's Findings

As noted in Chapter I, this study was conducted with two general purposes in mind. First, it was felt that a contribution could be made to the present state of knowledge relating to the overall functioning of the home mortgage default insurance market (including mortgagor default behavior) by the derivation and estimation of an economic model of this market. This effort was found to be particularly useful because of the paucity and methodological weakness of the literature existing in this area (see Chapter III). Second, it was felt that such an effort would provide a sound framework for an economic analysis of the decline of FHA that could serve as an important input in the development of federal policies relating to this market. Clearly, an understanding of the causal forces that have led to this decline is essential to the formulation of socially beneficial policy actions. Then, given these two basic purposes, the findings of this study may be conveniently categorized by their relation to either the general operations of the default insurance market or the FHA decline. We now summarize our findings and relate them to these two areas of concern.

With regard to the overall functioning of the default insurance market, this study contains three major findings. These flow from both the theoretical model and equation one of the empirical results.

First, we may infer from the theory contained in Chapter IV that the total volume of insurance market activity is directly dependent upon the number of loans originated in the mortgage market. This inference is far from surprising as it stems from the derived nature of the demand for mortgage insurance. Given the manner in which equation one was specified, this hypothesis could not be tested statistically in a direct fashion. It did, however, receive some empirical support in that the predicted values of the random coefficient relating mortgage originations to insurance contracts remained positive over all observations.

Second, while the market theory that was developed implied that the proportion of home mortgage originations that are insured in any given period would be directly related to both the level of the financing terms available on insured loans and the level of the supply constraints present in the non-Section 203 sub-markets, the econometric results appear to support only the latter hypothesis. But, since the price of insurance coverage is lowest in the non-Section 203 sub-markets (indeed, it is zero in two of them) and since the financing terms available are more liberal in two of these sub-markets, fluctuations in these supply constraint variables are likely to serve as proxies for movements in the average price and terms available on insured loans in general. From the theoretical model, these two factors (price of coverage and financing terms available) should be crucial in the decision of whether to insure a given loan and, as a result, should be important determinants of the proportion of originations insured. To the extent that our supply constraint variables have served as proxies for these factors, this hypothesis receives empirical support

from the estimation results of equation 1. The proportion of originations insured should increase with decreases in the price of insurance coverage and/or with increases in the loan-to-value ratios or terms to maturity available on insurance mortgages.

This leads to our third finding regarding the operations of the overall market. As the supply constraint in the private mortgage insurance sub-market becomes ineffective (i.e., as the volume of insurance written by these firms expands and the excess demand in that sub-market disappears) and as financing terms available on insured loans approach their upper limits, the proportion of single-family mortgage originations that are insured should become fairly constant at a relatively high level. Moreover, the total volume of insurance written should fluctuate even more closely with the number of mortgages originated in each period. This, in turn, implies that insurance suppliers will be unable to expand volume through further liberalization of acceptable financing terms. Such an outcome could lead to a growth in the amount of price competition exercised in this market (which has been noticeably absent in the past) and even further declines in the volume of insurance written under Section 203.

With regard to the decline in the FHA Section 203 program, this study contains six major findings that may be held with varying degrees of confidence according to the apparent accuracy and consistency (between equations) of the estimation results and the perceived degree of measurement error encountered in the quantification of the particular factor involved. These findings flow from the theoretical model and equations 4, 5, and 6 of the empirical results. First, an important cause of Section 203's long-run decline and present actuarial

problems has been the re-emergence and growth of the private mortgage insurance industry over the decade of the 1960's and into the 1970's. Such growth appears to have been at least partially spawned by the discriminatory pricing of default insurance coverage under the Section 203 program. The pooling of readily distinguishable heterogeneous risk classes under a single premium rate cannot survive in a competitive insurance market. This supply mechanism, which has been employed by FHA since the program began in 1934, has led to internal cross-subsidization of insurance premiums (with preferred risk customers subsidizing the premiums of higher risk customers) that, in turn, has made the eventual entry of private firms both profitable and inevitable. As a result, this pricing scheme has led to a long run decline in insurance volume and an increasing deterioration of the average underwriting quality of Section 203 insurance applications as the low risk business has been bid away by the private firms in the market. Although the single price supply mechanism historically employed by the private mortgage insurers (until very recently) has made the attainment of precise actuarial fairness impossible in this sub-market also, their lower rates have more closely approximated the marginal costs of providing coverage to the lower risk loans. Increasing competition within this sub-market should, over time, lead to a greater differentiation of risk classes and a movement toward actuarially fair rates.

Second, another important contributor to the Section 203 decline has been the provision of default insurance on subsidized basis by other programs operated by the federal government. Specifically, the default coverage provided under the Veterans Administration's home loan

guarantee program and the FHA single-family subsidized housing and default insurance programs was found to reduce the demand for Section 203 coverage. With the suspension of the Section 235 program in the spring of 1973, one source of competition has been eliminated. Also, present trends toward increased pay in the armed services and the movement toward an all-volunteer army may lead to an end of the VA loan guarantees, thus removing another source of competition for the Section 203 insurance program. Given a continued growth in the private mortgage insurance industry, however, the long run decline in Section 203 insurance volume should continue unless basic alterations are made in the program.

Third, net secondary market purchases of FHA insured single-family mortgages by FNMA, GNMA, and FHLMC increase the demand for Section 203 insurance. This effect may primarily result from the commitment procedure employed by these institutions in the purchase of loans. Such purchases have prevented the Section 203 decline from achieving the severity that it might have reached in the absence of these activities. As the secondary market adapts to private mortgage insurance coverage, however, this source of support may be expected to disappear and further declines in Section 203 demand will be forthcoming. This conclusion would tend to imply that the recent purchases by these secondary market participants have contributed to the mild upswing in Section 203 insurance volume during the last two quarters of 1974 and the first quarter of 1975. Although this upswing has been quite small in relation to the overall decline, it is seen by some as a signal of the end of the Section 203 decline. This study does not, however, support such a view.

Fourth, the long-run erosion of Section 203's relative financing-terms advantage *vis á vis* the private firms in the market has been a major cause of decline, at least with regard to the insurance volume that is written on new units. As the financing-term gap between Section 203 and conventional loan-to-value ratios and term to maturities has been narrowed, an important source of product differentiation has been lost and the substitutability between Section 203 and private coverage has increased. Given the lower price at which private insurance coverage is offered, such increases in substitutability have resulted in decreases in the demand for Section 203 coverage. Given the present level of these financing terms, it appears that this mechanism for differentiating the Section 203 product has been exhausted and that further declines may be anticipated as the financing-term gap closes.

Fifth, the FHA interest rate ceiling (with the resulting system of discount points) and the mortgage limit both appear to have contributed to the Section 203 decline. This result appears to be particularly strong for the insurance volume written on existing units. A plausible explanation of this differential impact was found for the interest rate variable, but the greater impact of the mortgage limit on existing units (reflected in both the size and estimation accuracy of the coefficient involved) remains an anomaly. Recent adjustments to both of these variables have apparently contributed to the upswing in Section 203 insurance activity also (see conclusion three above).

Finally, while there does exist some theoretical support for the notion that increases in FHA processing time (found to be influenced by the 1969 HUD reorganization) contributed to the declining volume of Section 203 activity, this notion is not supported by the empirical

findings of this study. Indeed, this hypothesis is directly contradicted in one of the estimated equations. Also, a similar conclusion applied to the imposition of additional processing requirements in the late 1960's and early 1970's (i.e., the A95 Review, Environmental Clearance, and Affirmative Marketing requirements). While the hypothesis that these requirements operated to reduce Section 203 demand is not contradicted by the empirical evidence (the negative sign attained by the coefficient is in agreement with this hypothesis), the coefficient is estimated with a large standard error. Therefore, the equation fails to support the hypothesis that these requirements were influential in reducing insurance volume. These conclusions, however, are held with less confidence than those above because of the severe measurement problems encountered in the variables that were incorporated to represent these particular influences. Given the present method of measuring processing time in the various FHA insuring offices and the difficulty involved in the quantification of discrete institutional changes in a time series model, there appears to be no way to obtain precise answers concerning these factors at this time.

#### Limitations of the Study

The accuracy of the findings summarized above is, of course, conditional upon the overall adequacy of the theoretical and empirical model employed in the study. The theoretical hypotheses that were derived hinge largely upon the assumptions adopted concerning the behavioral objectives of the various market participants, the effectiveness of certain institutional constraints imposed on the activities of these participants, and the degree of competition existing in the

markets involved. While the validity of the deductive process and the usefulness of the hypotheses derived from it are not entirely dependent upon the descriptive accuracy of these assumptions, some degree of correspondence must exist between the premises and the real world if the conclusions are to have any practical relevance. And, the statistical properties exhibited by the estimates that were obtained depend closely upon the satisfaction of basic assumptions regarding the quality of the data, the covariance matrix of the disturbance terms, and the structural and functional specification of the equations in the model. The important limitations of this study may be categorized into two broad groups: those relating to the adequacy of the data; and those relating to the use of untested maintained hypotheses. We now summarize these limitations.

With regard to the data employed in this study, there are five potential sources of error that appear to be particularly serious. First, the use of national data may have led to aggregation bias in the estimation results. As noted in Chapter VI, the conditions under which this bias would not have resulted are quite restrictive and unlikely to have been met. Second, the extent of variation observed in some of the variables that were found to be theoretically relevant was very disappointing. This was, of course, particularly true of the premium rates quoted for insurance coverage which failed to vary at all over the sample period. Third, there were practical difficulties encountered in attempting to quantify the influence of institutional or qualitative factors in the time series model. The binary variables that were employed could have captured the effects of any contemporaneous occurrences and, therefore, are subject to a certain amount of

ambiguity in the interpretation of their estimated coefficients.

Fourth, some potentially serious measurement errors were encountered in several of the variables employed. For reasons noted in Chapter VI, the series used to measure FHA processing time was considered to be the least reliable in this respect. And fifth, there were several variables for which data simply did not exist. For example, data were unavailable for the financing terms offered on privately insured loans and for the reserve accumulation of the private firms in the market. Because of these potentially serious data problems, the econometric results of the study should be interpreted with caution. Clearly the need for improved data in this area is great.

In addition to the limitations imposed on the study by these data considerations, we must also recognize the potential dangers involved in the use of untested, maintained hypotheses. Of those employed in this study, there appear to have been two that were particularly crucial to the results obtained. First, it was assumed that the total volume of home mortgage default insurance written was determined recursively from a three-sector system that included the housing sector, the mortgage sector, and the default insurance sector. It was hypothesized that the first two sectors were truly simultaneous in nature but that the outcome generated by the equilibrating process in these sectors was fed exogenously into the insurance sector with no simultaneous feedback effects. If this assumption is descriptively false, then uncorrected simultaneity is present in equations one, four, and five of the econometric model; and, as a result, the estimates obtained in these equations are biased and inconsistent. Correction of such simultaneity, however, would require at least knowledge of all exogenous variables in

the other two sectors of the larger system and, thereby, would entail a considerable expansion of the study.

And second, it was assumed that the institutional supply constraints present in the non-Section 203 sub-markets remained effective throughout the sample period. If these constraints did not exist or were not effective, then these sub-markets would reach equilibrium solutions without the use of non-price rationing and there would exist no excess demand to be channelled into the Section 203 sub-market. In this case, equations four and five of the econometric model would be over-specified because the quantities of insurance written in the VA, FHA subsidy program, and private insurance sub-markets could not be theoretically justified in the Section 203 demand equations. In the absence of any other econometric difficulties, such over-specification would not constitute a serious problem. If the quantities of insurance written in the non-Section 203 sub-markets were theoretically irrelevant to equations four and five, then the estimates of the coefficients of these variables would not be significantly different from zero and the estimates of the other coefficients in these equations would be unaffected by the inclusion of these quantities. But, given the presence of other potential estimation problems, we cannot be certain that this result would be forthcoming.

It should be noted, however, that most of the limitations summarized above are, to a varying degree, present in all economic studies (not that their presence in other studies obviates in any way the concern over their presence in this study). Assumptions must be made which, in turn, implies that complete descriptive accuracy cannot be attained (nor, for that matter, does it appear desirable to even attempt

to attain it). Empirical testing of theoretical hypotheses is always subject to qualifications relating to the adequacy of the data and the accuracy of the model's specification. It is the perennial presence of such qualifications that distinguishes empirical verification from absolute proof.

#### Contributions of this Study to the Existing Economic Literature

There are at least three areas in which this study may be seen to contribute to the existing economic literature. First, with regard to previous studies of mortgagor default behavior, the theory contained in Chapter IV fills a large void (see Baza and Kirzner, 1975; Herzog and Earley, 1970; Knight, 1969; von Furstenberg, 1969, 1970a, 1970b, 1970c, 1971, and 1974; Williams *et al.*, 1973). The literature concerned with this topic has, until now, incorporated little or no explicit theoretical treatment of the individual mortgagor's decision to default on his loan (see Chapter III). For the most part, these studies have depended exclusively upon empirical analyses of default probabilities on either individual mortgages or, more commonly, groups of mortgages. Their conclusions have been derived primarily from the estimation results obtained from relationships that have been specified in an *ad hoc* fashion. As a result, one observes a considerable amount of variation in the list of factors that are included in the vector of independent variables utilized in the regression equations and in the emphasis placed on particular causal factors. This study complements this body of literature by providing a theoretical treatment of the default phenomenon. At the same time, however, this theory reveals an important shortcoming

in these previous efforts. This shortcoming lies in the failure of these studies to extend the analysis beyond simple default probabilities to investigate expected default losses. It is the latter of these variables that is of primary interest to the mortgage lending institution and the default insurance firm (along with the variation in default loss about this expected value). The model derived in Chapter IV provides a theoretical construct for the analysis of expected default loss.

Second, the study makes a contribution to the theory of the mortgage market by clarifying the function that is served by default insurance coverage in the mortgage contracting process (Aaron, 1972). By shifting the burden of default loss from the lender to the insurer, the mortgagor can, under conditions derived in Chapter IV, reduce his effective interest charge even after allowance is made for the cost of providing coverage. The anomaly encountered in Aaron's estimates of the benefits derived from default insurance coverage (that some mortgagors appeared to be deriving negative net benefits from voluntary participation in the FHA program) is readily explained in this analysis by his failure to account for the risk premium required by risk averse lenders. It is clear from the inequality given in expression (24) of Chapter IV that expected default loss could be smaller than the insurance premium paid by the borrower and still have positive net benefits received by that borrower. Intraprogram transfers that arise from non-actuarially fair insurance rates can be measured using the methodology adopted by Aaron, but net benefits cannot. Also, the more general approach adopted here reveals the various tradeoffs available to borrowers between interest charges, insurance coverage, and loan contract terms;

and, it does not require the adoption of specific utility functions as is required by the indifference curve approach employed by Aaron.

And third, this study makes a contribution to the literature by providing the first comprehensive economic analysis of the home mortgage default insurance market. The almost complete absence of previous studies in this area might be attributed to the dominance of federal government programs in this market in the past. Such dominance is revealed in previous housing market studies by the usual practice of stratifying housing starts into two categories labeled federally-insured and conventional with no distinction made in the latter category between privately insured and uninsured starts. The rapid growth of the private mortgage insurance industry and the liberalization of financing terms on privately insured loans over the last decade render this practice no longer valid. Such growth also, in itself, raises many issues that have both academic and policy relevance. The analysis contained in this study should provide a first step toward the investigation of these issues.

#### Areas for Future Research

As with most research efforts, the analysis contained in this study has surfaced many issues that appear to provide fertile topics for future investigation. Some of these represent rather straightforward extensions of the model that has been developed here while others would require an entirely new approach. Five such areas immediately come to mind. First, there are at least three ways in which the empirical results reported in this study could be usefully subjected to further verification. Given the likely presence of aggregation bias in

the estimation results of this study, it would be useful to examine the FHA decline from a regional perspective, perhaps making use of available state data. A potential weakness in such a cross-sectional approach would be the inability to incorporate institutional changes that have occurred over time for the nation as a whole. Also, a problem might be encountered in the degree of variation that could be observed in some of the variables employed (such as interest rates, financing terms, and FHA mortgage limits). But, given the variety of cross-sectional experience observed in FHA activity, such a study should be attempted. Similarly, replication of the empirical results might be carried out with monthly data that begin in the mid-1960's. Such an exercise would allow for greater refinement in the treatment of certain qualitative variables. For example, monthly data would enable one to estimate separate coefficients for the three processing requirements imposed on FHA in the 1969-1971 period. Such data would also allow one to maintain an adequate number of observations without resorting to the lower quality data of earlier periods. Finally, the indirect tests of the cream-skimming hypothesis contained in this study could be subject to more direct verification through the use of individual mortgage observations. It appears that a profit analysis of the probability that a given loan will be insured by FHA or by a private mortgage insurance firm would be capable of providing such verification.

Second, this study highlights the need for further work in the area of mortgagor default behavior. Such an effort would, obviously, entail more than a mere replication or previous investigations of this topic. The theory contained in Chapter IV could be made operational by specifying those variables that are theoretically relevant to the time

path of property values and, perhaps, those factors that might be expected to influence the value to an individual of his credit rating. Then, with individual loans as the units of observation, the analysis could be applied to both default probability and expected default loss through use of the tobit estimation procedure. In this manner, a more definitive analysis of home mortgage default risk could be carried out.

Third, a complete incorporation of the single-sector model contained in this study into a larger system of equations that captures housing market and mortgage market sectors with the elimination of the assumption of recursiveness would appear to be useful. Mortgage origination could be stratified by the financing terms obtained and the supply of the higher-risk loans (those with more liberal terms) could be hypothesized to depend upon the availability of default insurance coverage on such loans. This undertaking would be quite difficult and might require certain data that are, as yet, unavailable. Given the present state of knowledge in this area, however, a significant contribution could be made by the development of a rigorous theoretical model of the interactions between these three markets even in the absence of sufficient data to fully verify such a model.

Fourth, while not directly implied by the analysis in this study, it would appear that an investigation of the role of coinsurance in the home mortgage default insurance market would be useful. Here, there seems to be at least two important areas of concern. The first involves the question of the existence and seriousness of a moral hazard in the provision of coverage in this market. There are at least three potential sources of moral hazard in this area of insurance. First, there is the standard source found in the costs to the insured entity

of carrying out the claims-reducing behavior. Second, the existence of discount points paid to the lender at origination often makes it feasible to obtain a higher yield on insured loans that terminate in foreclosure than those that are successfully retired. And third, if there exist (as one's intuition might suggest) economies of scale in the covering of default loss (the risk-spreading aspect of the insurance function) but diseconomies of scale in the assessment of the risk on individual loans (the underwriting aspect of the insurance function), then efficiency considerations might dictate that lenders perform the latter function and be subjected to post-insurance reviews. This is the technique presently employed by the private mortgage insurers; and, since it involves giving the insurance entity the major responsibility for underwriting, it clearly requires the use of some form of coinsurance.

This raises the second area of concern which deals with the appropriate coinsurance mechanism to adopt. There are three basic schemes available. The first involves the complete coverage of the top portion of any loss experienced (used by the private mortgage insurers and the VA guarantee program). The second involves the complete coverage of the bottom portion of any loss experienced (most deductible insurance plans fall in this category). And the third involves a percentage sharing of all losses experienced. The choice of which mechanism to use would seem to depend upon the nature of the change in the frequency distribution of default loss that is brought about by the presence of the particular moral hazard involved. For example, if the moral hazard shifts the frequency distribution of default loss upward relative to the distribution given by the state of nature in such a way

that large losses become more frequent but small losses remain constant, then a coverage of the top portion of the loan that leaves the lender exposed to the larger losses would seem appropriate. These issues could be rigorously examined in both a theoretical and an empirical framework, and a significant contribution might be made to both the insurance theory in general and to the question of the role of coinsurance in the acceptance of home mortgage default risk in particular.

Finally, useful information might be gleaned from an analysis of the default insurance needs of the secondary mortgage market. As noted in the text, the investor in this market might prefer a higher level of coverage than that required in the primary market. Unlike the primary lender, the typical secondary market investor is completely unfamiliar with both the borrower of the funds and the property that secures the mortgage. Because of this additional uncertainty, the greater coverage provided on FHA insured loans may be more highly valued by the secondary market investor than it is by the primary lender. The decline of FHA in the primary market could, therefore, reduce somewhat the volume of investment activity in the secondary mortgage market. Alternative mechanisms might be investigated for providing a higher level of coverage in this market (through, for example, some form of portfolio insurance). A comprehensive examination of this issue could have important policy implications as the FHA decline proceeds.

The Need for a Basic Change in the Federal  
Government's Role in the Home Mortgage  
Default Insurance Market

The future role of FHA in the insurance of default risk on home mortgages hinges upon the policy decisions made (or not made) over the

next several years. It is hoped that information contained in this study will contribute to the decision-making process by providing an accurate, objective representation of the causal events that have led to the present situation and will, if no changes are instituted, continue to operate.

The study itself has not directly addressed the more fundamental question of whether FHA's continued presence in the market for unsubsidized default insurance on single-family properties is warranted in the present environment. Consideration of this question raises issues concerning the competitiveness (both present and potential) of the private mortgage insurance industry, the ultimate ability of the secondary mortgage market to adapt to private coverage, and many other important concerns. Given the evidence presented in this study, however, it would appear that the private market's ability to adequately meet the default insurance demands of the single-family market are quickly approaching the level at which federal involvement will no longer be required. As these conditions are approached, policy makers should be careful to assure that one of the federal government's oldest housing programs does not become a pensioner of the public interest.

## APPENDICES

## APPENDIX 1

### Hypothesis Tests for Regression Coefficients

As mentioned in the text, it is not statistically legitimate to carry out multiple hypothesis tests on the estimation results from a single sample. Ideally, one would draw a new sample to test each hypothesis put forth. Therefore, significance levels for the estimates obtained were not presented in the text nor were they discussed in the interpretation of those estimates. Individual readers, however, may want to know the level of significance for a particular hypothesis. To aid such readers, the following tables have been prepared giving the hypothesized signs, estimated signs, and significance levels of the coefficients that have been estimated for each equation in the empirical model.

It should be recalled that these tests must be interpreted as being asymptotic in nature for all equations except the first (Table A1.1 below). Since the estimated coefficients follow the  $t$  distribution and since this distribution is asymptotically normal, the  $t$ -test was applied in calculating the significance levels of the coefficients of equation 1 and the normal table was employed in calculating the significance levels of the coefficients of equations 2 through 6 (see Dhrymes, 1970, p. 166). All tests are one-tailed.

Table Al.1. Regression Results for Total Insurance Volume Equation,  
Dependent Variable: TOT/ORIG

| Independent Variable | Estimated Coefficient | Hypothesized Sign | Estimated Sign | Significance Level |
|----------------------|-----------------------|-------------------|----------------|--------------------|
| Constant             | 71.0853               | (+)               | (+)            | .01                |
| LFHA                 | -0.7884               | (+)               | (-)            | .01                |
| TFHA                 | 0.0471                | (+)               | (+)            | .28                |
| VET                  | 0.0004                | (+)               | (+)            | .01                |
| SD                   | 4.7954                | (+)               | (+)            | .01                |
| PMIA                 | 11.0117               | (+)               | (+)            | .01                |

Table Al.2. Regression Results for VA Insurance Volume Equation,  
Dependent Variable: VA

| Independent Variable | Estimated Coefficient | Hypothesized Sign | Estimated Sign | Significance Level |
|----------------------|-----------------------|-------------------|----------------|--------------------|
| Constant             | 27988.7185            | none              | (+)            | .1736              |
| VET                  | 2.6023                | (+)               | (+)            | .0838              |

Table A1.3. Regression Results for Private Insurance Volume Equation,  
Dependent Variable: PMI

| Independent Variable | Estimated Coefficient | Hypothesized Sign | Estimated Sign | Significance Level |
|----------------------|-----------------------|-------------------|----------------|--------------------|
| Constant             | -420558.6297          | none              | (-)            | .0136              |
| PMIA                 | -29050                | (+)               | (-)            | .3372              |
| PMIA1                | 9610                  | (+)               | (+)            | .4207              |
| PMIA2                | 40740                 | (+)               | (+)            | .1379              |
| PMIA3                | 64360                 | (+)               | (+)            | .0446              |
| PMIA4                | 80450                 | (+)               | (+)            | .0268              |
| PMIA5                | 89020                 | (+)               | (+)            | .0217              |
| PMIA6                | 90070                 | (+)               | (+)            | .0179              |
| PMIA7                | 83600                 | (+)               | (+)            | .0139              |
| PMIA8                | 69610                 | (+)               | (+)            | .0129              |
| PMIA9                | 48090                 | (+)               | (+)            | .0495              |
| PMIA10               | 19060                 | (+)               | (+)            | .3192              |
| PMIA11               | -17500                | (+)               | (-)            | .3936              |

Table A1.4. Regression Results for Section 203 New Units Insurance  
Volume Equation, Dependent Variable: FHAN

| Independent<br>Variable | Estimated<br>Coefficient | Hypothesized<br>Sign | Estimated<br>Sign | Significance<br>Level |
|-------------------------|--------------------------|----------------------|-------------------|-----------------------|
| Constant                | 198.5872                 | none                 | (+)               | .4960                 |
| PROC                    | -465.4113                | (+)                  | (-)               | .0401                 |
| PMI                     | -0.0707                  | (-)                  | (-)               | .1038                 |
| VAN                     | -0.0772                  | (-)                  | (-)               | .0025                 |
| SUBN                    | -0.5349                  | (-)                  | (-)               | .0048                 |
| TRM                     | 1484.8154                | (+)                  | (+)               | .0262                 |
| LTV                     | 1754.6223                | (+)                  | (+)               | .0010                 |
| I                       | -2399.7518               | (-)                  | (-)               | .1335                 |
| SEC                     | 2.3357                   | (+)                  | (+)               | .0495                 |
| LIMN                    | 0.2595                   | (+)                  | (+)               | .1736                 |
| D                       | -2834.9750               | (-)                  | (-)               | .2981                 |
| STS                     | 13684.5238               | (+)                  | (+)               | .0010                 |

Table Al.5. Regression Results for Section 203 Existing Units  
Insurance Volume Equation, Dependent Variable: FHAE

| Independent Variable | Estimated Coefficient | Hypothesized Sign | Estimated Sign | Significance Level |
|----------------------|-----------------------|-------------------|----------------|--------------------|
| Constant             | 31375.1970            | none              | (+)            | .2912              |
| PROC                 | 53.0163               | (+)               | (+)            | .4483              |
| PMI                  | -0.5118               | (-)               | (-)            | .0010              |
| VAE                  | -0.3298               | (-)               | (-)            | .0125              |
| SUBE                 | -1.0623               | (-)               | (-)            | .1736              |
| TRM                  | 1489.7717             | (+)               | (+)            | .2810              |
| LTV                  | -3176.6337            | (+)               | (-)            | .0016              |
| I                    | -20884.4941           | (-)               | (-)            | .0010              |
| SEC                  | 5.5557                | (+)               | (+)            | .1003              |
| LIME                 | 4.2575                | (+)               | (+)            | .0010              |
| STS                  | 53062.7643            | (+)               | (+)            | .0010              |

Table Al.6. Regression Results for FHA Single-Family Processing Time  
Equation, Dependent Variable: PROC

| Independent Variable | Estimated Coefficient | Hypothesized Sign | Estimated Sign | Significance Level |
|----------------------|-----------------------|-------------------|----------------|--------------------|
| Constant             | 125.7520              | none              | (+)            | .0010              |
| FHAT                 | -0.0002               | (-)               | (-)            | .0078              |
| LOAD                 | -556.1184             | (+)               | (-)            | .1151              |
| REOR                 | -19.9460              | (-)               | (-)            | .0010              |

## APPENDIX 2

### Variable Definitions and Data Sources

The variables employed in the empirical model of this study are defined below, and their sources are given. They are presented in alphabetical order.

- D = a binary variable that is set equal to zero prior to the second quarter of 1972 and is equal to one thereafter intended to pick up the gross effects of FHA processing requirements.
- FHAE = number of existing units insured by FHA under the Section 203 program. Source: Federal Housing Administration, Department of Housing and Urban Development, *FHA Monthly Report of Operations--Home Mortgage Programs*, RR:301 (Homes).
- FHAN = number of new units insured by FHA under the Section 203 program. Source: Federal Housing Administration, Department of Housing and Urban Development, *FHA Monthly Report of Operations--Home Mortgage Programs*, RR:301 (Homes).
- FHAT = total number of single-family units insured by FHA, both new and existing, subsidized and unsubsidized. Source: Federal Housing Administration, Department of Housing and Urban Development, *FHA Monthly Report of Operations--Home Mortgage Programs*, RR:301 (Homes).
- FORC<sub>i</sub> = total number of FHA Section 203 insured loans terminating in default by the end of the  $i^{th}$  year after endorsement divided by the total number endorsed in the reference year. Source: data obtained from the Actuarial Division, Office of Management Systems, Housing Production and Mortgage Credit, Department of Housing and Urban Development.
- I = the difference between the average interest rate on conventionally financed loans and the average effective interest rate on FHA insured loans. Source: the two series used to construct this variable are in Eugene A Brady, "The Quarterly National Housing Market Data Bank of the Federal Home Loan Bank Board," Working Paper #22, Federal Home Loan Bank Board, Washington, D. C., 1971.

- IN =  $(\text{CPI} - \text{CPI}(-1))/\text{CPI}(-1)$ , the annual percentage rate of inflation where CPI is the Consumer Price Index. Source: Data Resources Incorporated Central Data Base.
- LFHA = average loan-to-value ratio on FHA Section 203 insured loans. Source: Eugene A. Brady, "The Quarterly National Housing Market Data Bank of the Federal Home Loan Bank Board," Working Paper #22, Federal Home Loan Bank Board, Washington, D. C., 1971.
- LIME = the difference between the FHA mortgage limit and the average price of existing homes sold. Source: the mortgage limit series was obtained from the Division of Research and Statistics, Department of Housing and Urban Development, and the average price series was obtained from the *Federal Reserve Bulletin*.
- LOAD =  $\text{MANYR}/\text{APPL}$ , where MANYR is the average quarterly number of man-years devoted to initial processing of single-family insurance applications in FHA, and APPL is the total number of single-family applications received. Source: MANYR was obtained from the Federal Housing Administration Budget Office and APPL was obtained from Federal Housing Administration Department of Housing and Urban Development, *FHA Monthly Report of Operations--Home Mortgage Programs*, RR:301 (Homes).
- LTV = the difference between the average loan-to-value ratio on FHA Section 203 insured loans and conventionally financed loans. Source: both series used to construct this variable are from Eugene A. Brady, "The Quarterly National Housing Market Data Bank of the Federal Home Loan Bank Board," Working Paper #22, Federal Home Loan Bank Board, Washington, D. C., 1971.
- ORIG = volume of single-family mortgage originations in millions of 1971 dollars. Source: constructed by this author from two sources--Arnold Diamond, *Mortgage Loan Gross Flows*, U.S. Department of Housing and Urban Development and the *Federal Reserve Bulletin*.
- PMI = number of single-family units (both new and existing) insured by the private mortgage insurance industry. Source: data obtained from Mortgage Insurance Companies of America, 1825 K Street, Washington, D. C., 20006.
- 50
- PMIA =  $\sum_{i=1}^n d_i w_i$  = an index of the availability of private mortgage insurance, where  $d_i$  are dummy variables equal to one after private mortgage insurance first entered state  $i$  and zero before, and  $w_i$  are weights equal to the number of single-family homes in state  $i$  divided by the total number of single-family homes in the U.S. in 1970. Source: the dates at which private mortgage insurance

become available in each state were obtained from the Mortgage Guaranty Insurance Corporation, Milwaukee, Wisconsin; and the number of single-family homes in each state was taken from Table 22 of the 1970 *Census of Housing*.

$PMIA_i$  = PMIA lagged  $i$  quarters.

PROC = percent of single-family FHA insurance applications processed within five days, averaged over insuring offices and aggregated from weekly observations. Source: Weekly Report of Operations, FHA Form 2498, Management Information Division, Federal Housing Administration, Department of Housing and Urban Development.

REOR = a binary variable that is set equal to one beginning in the first quarter of 1970 and is equal to zero before.

SD = a binary variable that is set equal to one over the 1968-1971 period and is equal to zero in all other periods.

SEC = net secondary market purchases (gross purchases minus gross sales) of FHA insured mortgages by the Federal National Mortgage Association, the Government National Mortgage Association, and the Federal Home Loan Mortgage Association in millions of 1971 dollars. Source: all series used in constructing this variable are from the *Federal Reserve Bulletin*.

STS = total number of single-family nonfarm housing starts in millions of units. Source: Data Resources Incorporated Central Data Base.

SUBE = number of existing units insured by FHA under its single-family subsidy programs (primarily Section 235). Source: Federal Housing Administration, Department of Housing and Urban Development, *FHA Monthly Report of Operations--Home Mortgage Programs*, RR:301 (Homes).

SUBN = number of new units insured by FHA under its single-family subsidy programs (primarily Section 235). Source: Federal Housing Administration, Department of Housing and Urban Development, *FHA Monthly Report of Operations--Home Mortgage Programs*, RR:301 (Homes).

TFHA = average term to maturity on Section 203 insured loans. Source: Eugene A. Brady, "The Quarterly National Housing Market Data Bank of the Federal Home Loan Bank Board," Working Paper #22, Federal Home Loan Bank Board, Washington, D. C., 1971.

TOT =  $FHAN + FHA E + SUBN + SUBE + VAN + VAE + PMI$  = the total number of single-family units insured, defined here as

the sum of the single-family insurance volumes of FHA (Section 203 plus subsidy program volumes), VA, and the private firms in the market. Source: see the sources of the variables used to construct this series.

- TRM = the difference between the average term to maturity on Section 203 insured loans and conventionally financed loans. Source: both series used to construct this variable are from Eugene A. Brady, "The Quarterly National Housing Market Data Bank of the Federal Home Loan Bank Board," Working Paper #22, Federal Home Loan Bank Board, Washington, D. C., 1971.
- UN = annual percentage rate of unemployment in the U.S. Source: Data Resources Incorporated Central Data Base.
- VA = number of single-family mortgage guarantees issued by the Veterans Administration for both new and existing properties. Source: Statistics Office of the Veterans Administration, Washington, D. C.
- VAE = number of single-family mortgage guarantees issued by the Veterans Administration for existing properties. Source: same as for VA above.
- VAN = number of single-family mortgage guarantees issued by the Veterans Administration for new properties. Source: same as for VA above.
- VET = number of veterans eligible for VA loan guarantees. Source: Eugene A. Brady, "The Quarterly National Housing Market Data Bank of the Federal Home Loan Bank Board," Working Paper #22, Federal Home Loan Bank Board, Washington, D. C., 1971.

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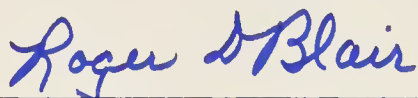
## BIOGRAPHICAL SKETCH

The author was born on September 22, 1947, in Knoxville, Tennessee. He graduated from East High School in May, 1965, and entered the College of Liberal Arts of the University of Tennessee in September of that year. He graduated from that institution in August, 1970, with the Bachelor of Science degree with a major in economics and minors in mathematics and political science.

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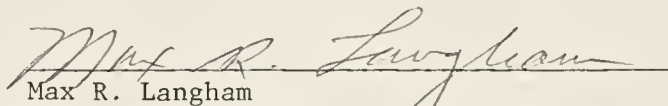
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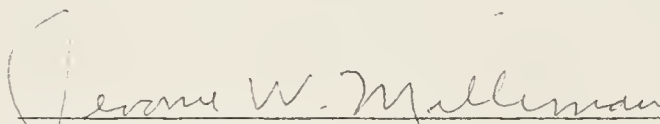
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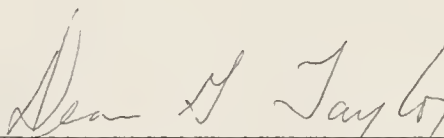
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This dissertation was submitted to the Graduate Faculty of the Department of Economics in the College of Business Administration and to the Graduate Council, and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

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